Improvements in the Version 2.0 RapidSCAT Ocean Vector Winds

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Ocean Vector Wind Science Team Meeting

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Overview

- Version 2.0 of the climate quality RapidScat swath wind data products has been publicly released at the Physical Oceanography Data Active Archive Center (PO.DAAC) https://podaac.jpl.nasa.gov, The new version includes:
- New SST-dependent GMF (Ricciardulli and Wentz, 2018)
  - *Fixes speed biases with C-band scatterometers and radiometers in cold ocean.*
  - *Reduces directional discontinuities in center of swath near 50 degrees South.*
- New simplified flagging strategy
  - *One flag bit denotes data that is likely to be contaminated by rain, sea-ice or other less frequent issues. Excludes 3% of data. This bit is NOT set for coastal processed data.*
  - *Another stricter flag is also included which flags all data that has the possibility of contamination including data near land (coastal processed data) near ice, near rain, and data for which the rain flag is undetermined. Excludes 15% of data.*
- External rain information
  - *External co-located microwave radiometer data is used to aid in rain flagging*
  - *When available rain rate information, co-location time difference, and radiometer satellite ID is provided.*

Flag Bits (new bits in red)

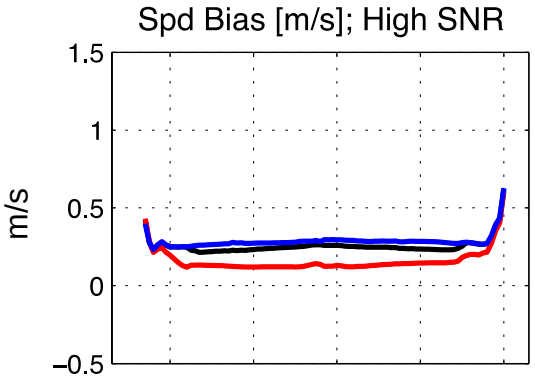
Variable ShortName flags LongName "Wind Vector Cell Quality Flags"

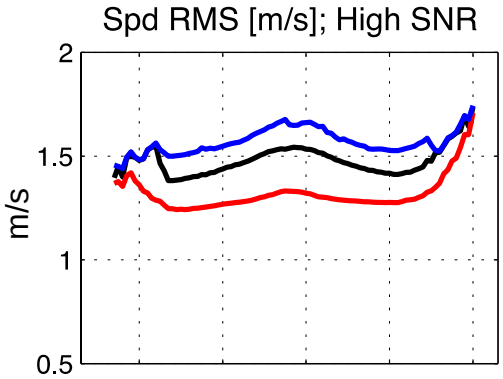
Bit 0: name adequate_sigma0_flag	Fewer than 4 sigma-0 values in wind vector cell, winds not retrieved
Bit 1: name adequate_azimuth_diversity_flag	Less than 20 degrees of azimuth diversity, winds not retrieved
Bit 2: name radiometer_does_not_exist_flag	No coincident radiometer data is available for this wind vector cell
Bit 3: name radiometer_rain_flag	Radiometer detects non-zero rain rate
Bit 4: name undefined_bit	
Bit 5: name undefined_bit	
Bit 6: name wind_retrieval_likely_corrupted_flag	Recommended flag, flags 3% of data when either sea ice, or rain is present.
Bit 7: name coastal_flag	At least one measurement in wind vector cell within 20 km of land.
Bit 8: name ice_edge_flag	At least one measurement in cell determined to be sea-ice contaminated
Bit 9: name winds_not_retrieved_flag	No wind vector retrieved
Bit 10: name high_wind_speed_flag	Retrieved wind speed greater than 30 m/s
Bit 11: name low_wind_speed_flag	Retrieved wind speed less than 3 m/s
Bit 12: name rain_impact_flag_not_usable_flag	Rain impact (IMUDH) flag is not computed, presence of rain unknown
Bit 13: name rain_impact_flag	Rain impact (IMUDH) flag, rain detected in cell
Bit 14: name missing_look_flag	At least one of the four azimuth looks is unavailable for this cell
Bit 15: name undefined_bit	

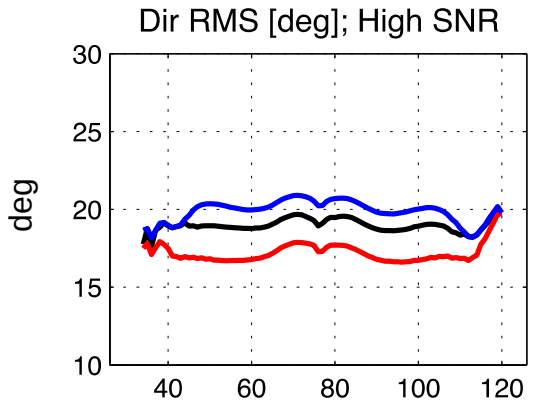
Variable ShortName eflags LongName "Extended Wind Vector Cell Quality Flags"

Bit 0: name rain_correction_not_applied_flag	Rain correction was not applied, this is typical when no rain is present
Bit 1: name correction_produced_negative_spd_flag	Rain correction produced a negative speed
Bit 2: name all_ambiguities_contribute_to_nudging_flag	All of the ambiguities in the cell were used during nudging
Bit 3: name large_rain_correction_flag	Rain correction to wind speed was larger than 1.0 m/s
Bit 4: name coastal_processing_applied_flag	Always zero no coastal processing.
Bit 7-5: name radiometer_sat_id_bits	Three bit field that identifies coincident radiometer (e.g WindSAT = 100 (bit7,bit6,bit5))
Bit 8: name rain_nearby_flag	Rain detected within 50 km of cell.
Bit 9: name ice_nearby_flag	Sea ice detected within 50 km of cell
Bit 10: name significant_rain_correction_flag	Rain speed correction was larger than 0.1 m/s
Bit 11: name rain_correction_applied_flag	Rain correction was applied, inverse of bit 0.
Bit 12: name wind_retrieval_possibly_corrupted_flag	Strict flag, flags 15% of data with rain or sea ice is nearby or coastal processing performed
Bit 13: name undefined_bit	
Bit 14: name undefined_bit	
Bit 15: name undefined_bit	

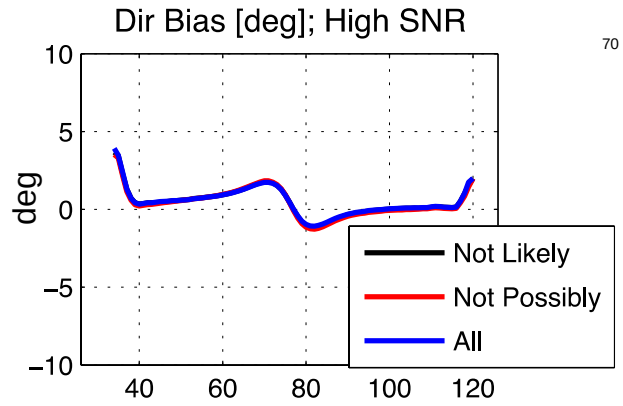
Simplified Flagging Performance (Wind difference statistics w.r.t ECMWF)







Cross Track Index (12.5-km units)



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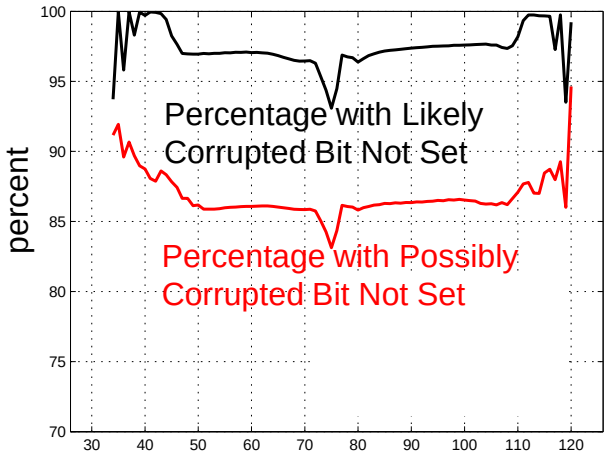


Cross Track Index (12.5-km units)

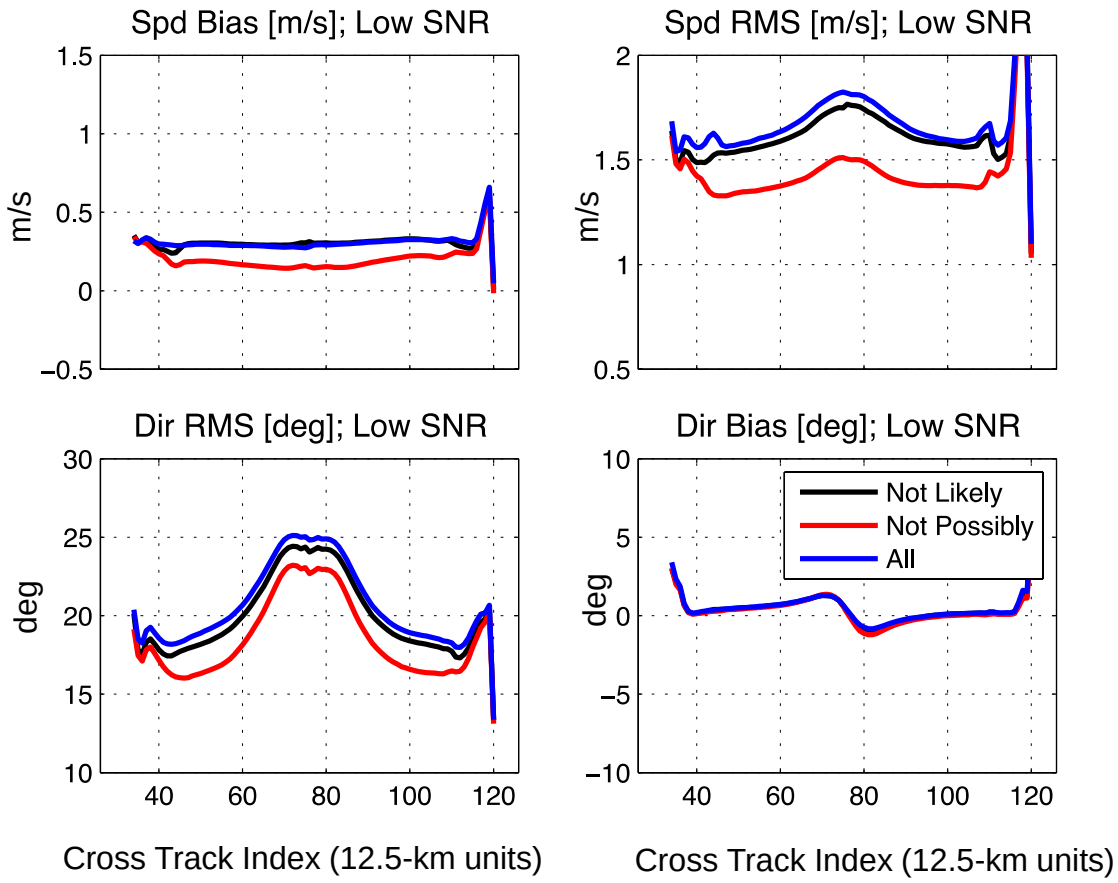
Likely Corrupted means one of these is true

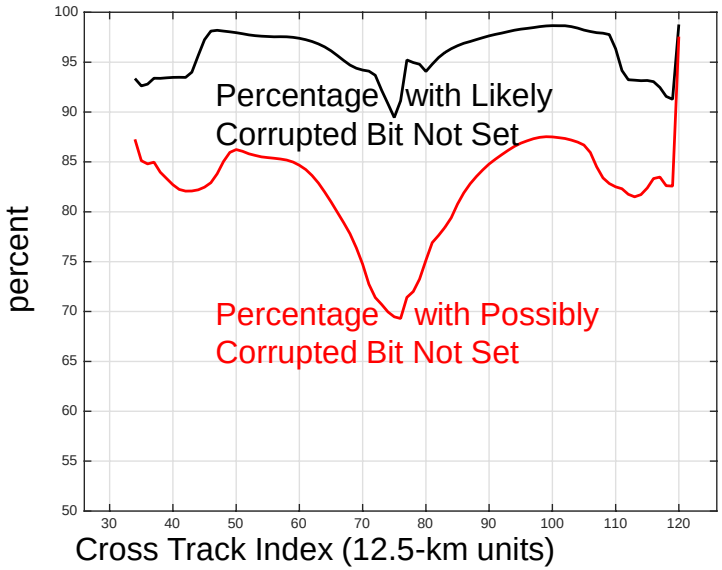
- Autonomous Rain Flag (IMUDH) indicates rain contamination.
- Speed corrected by more than 2 m/s
- Sea ice found in Wind Vector Cell
- Scatterometer rain flag unavailable and radiometer indicates rain within 90 minutes
- Wind was not retrieved or had invalid value.

Possibly corrupted means one of these is true

- Likely Corrupted Bit set
- Rain flag set within 50-km
- Sea-ice flag set within 50-km
- Speed was corrected for rain by more than 0.1 m/s

Simplified Flagging Performance (Wind difference statistics w.r.t ECMWF)





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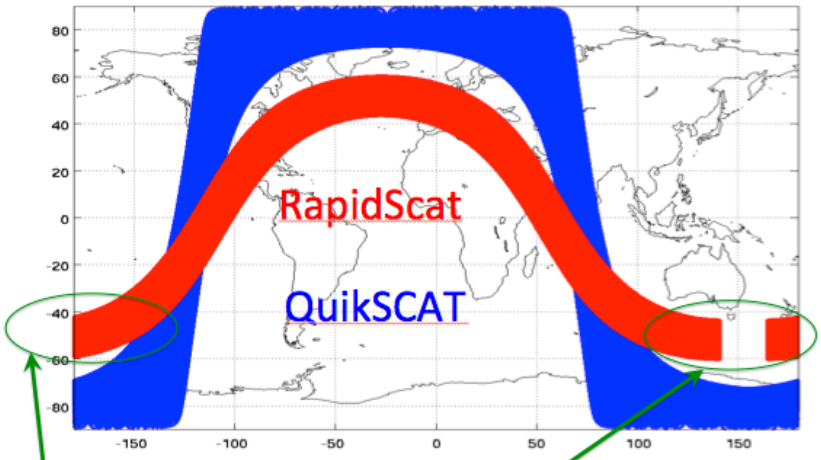
Possibly corrupted means one of these is true

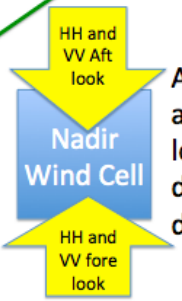
- Likely Corrupted Bit set
- Rain flag set for more than 3 of 7x7 neighbors
- Sea-ice flag set within 50-km
- Speed was corrected for rain by more than 0.1 m/s

SST-dependent GMF Directional Artifact removal

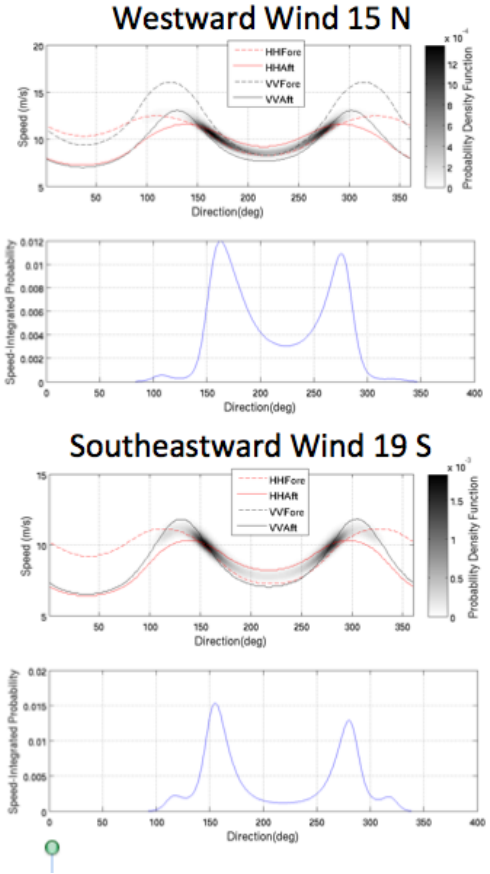
- Directional errors at the center of the swath are worse when the radar look vector is parallel to the wind.
- This happens more frequently for RapidScat, due to eastward motion of the ISS over the southern ocean.
- The problem was compounded in Version 1 due due GMF errors that the SST-dependent GMF alleviates.

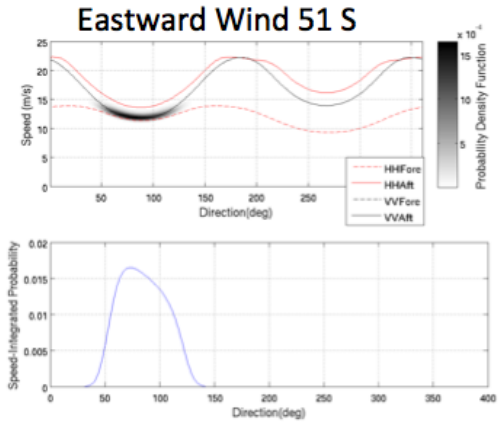


Look vectors in center of swath point along swath, parallel to predominant east/west wind direction



At nadir there are only two look directions, 180 degrees apart.



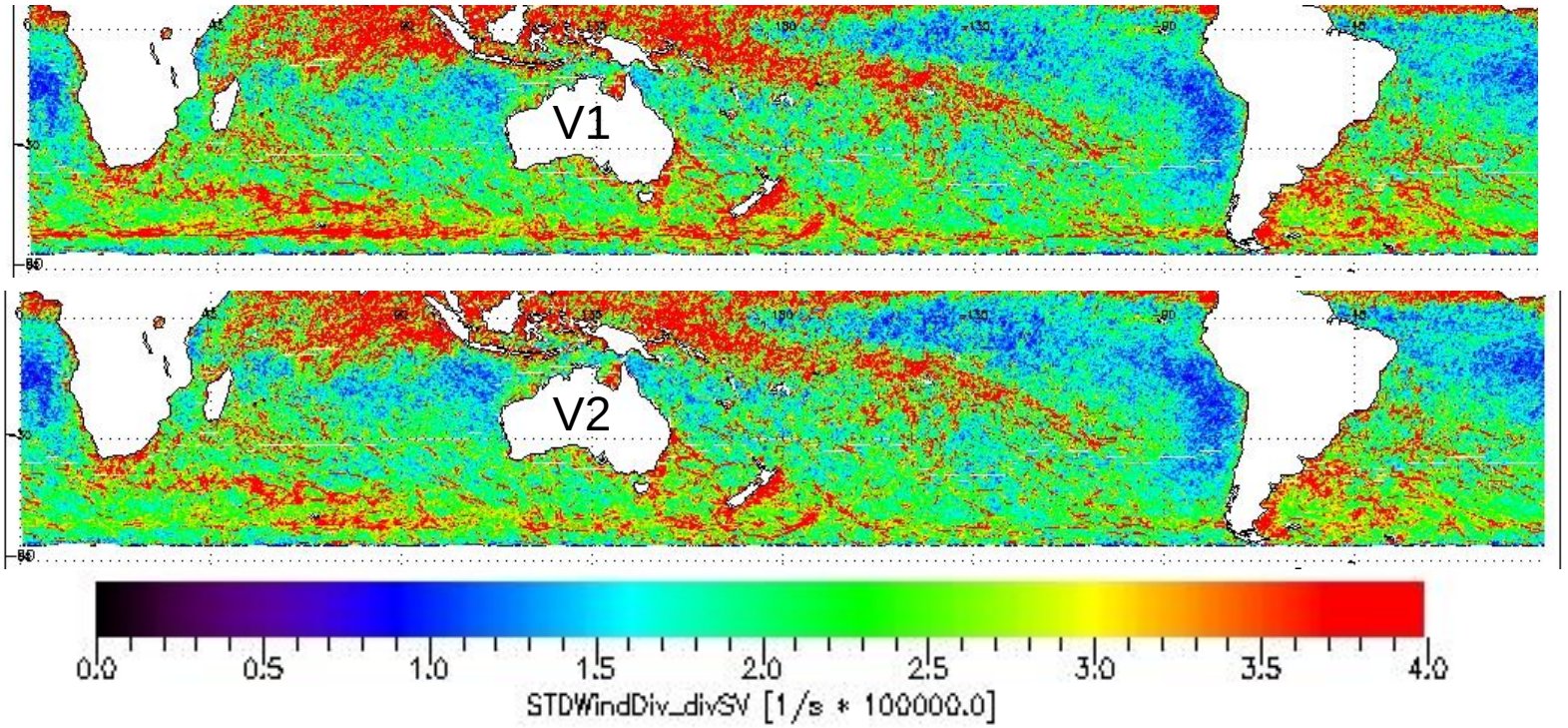


PDFs for three RapidScat nadir wind cells

1. Eastward Wind at 51 S latitude.
   - Wind parallel to look vector
   - Solution curves for different looks close together for wide range of directions.
   - Large plateau in PDF, poor directional performance
2. Westward Wind at 15 N latitude.
   - RapidScat performance better for east/east winds near equator because swath is no longer east/west
   - Two distinct narrower ambiguities.
3. Southeastward Wind at 19 S latitude.
   - Winds nearly perpendicular to swath lead to better performance in the nadir wind cell.
   - Similar to QuikSCAT viewing geometry for east/west winds.

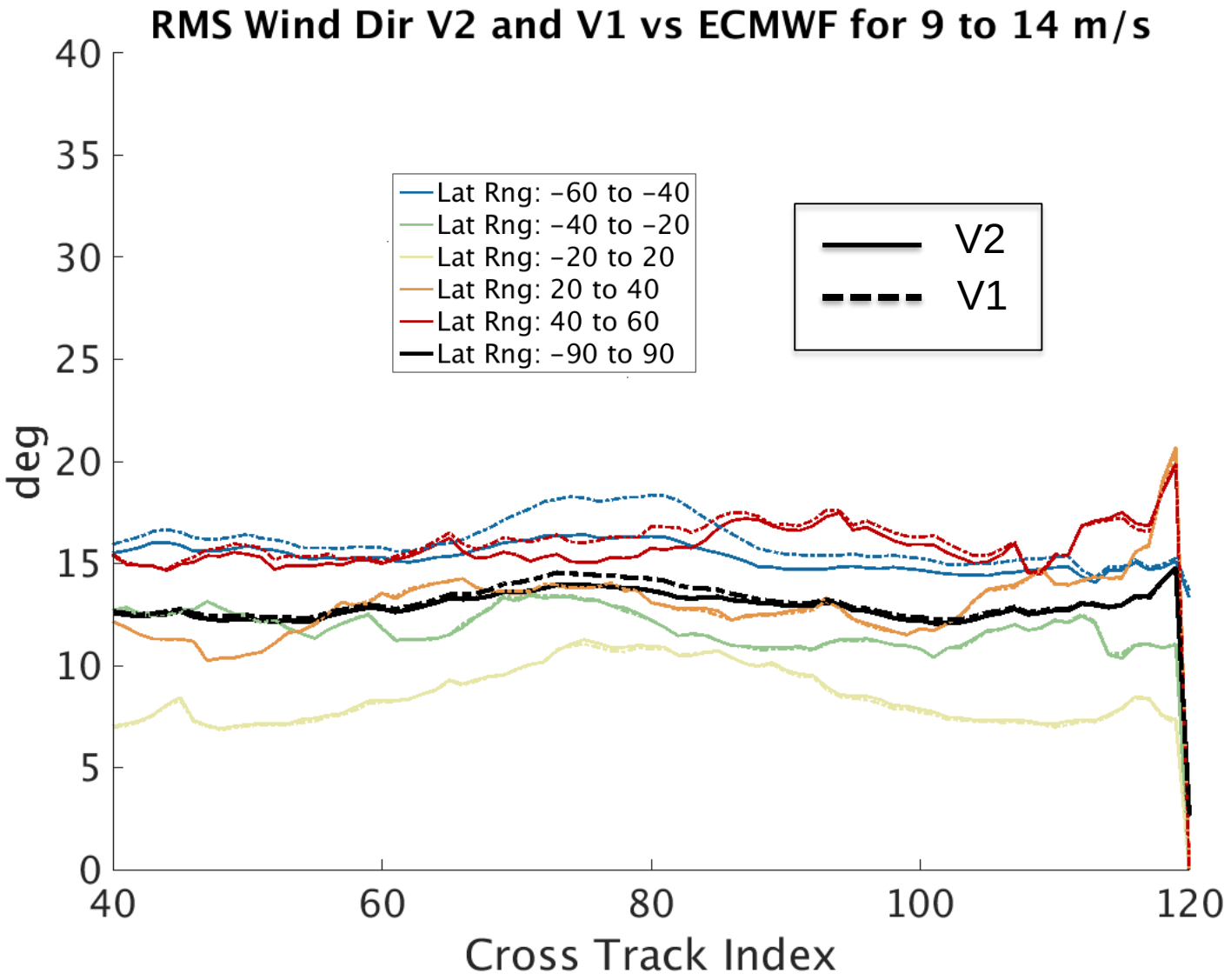
SST-dependent GMF Directional Artifact removal

Standard Deviation of Wind divergence fields , November 2014,

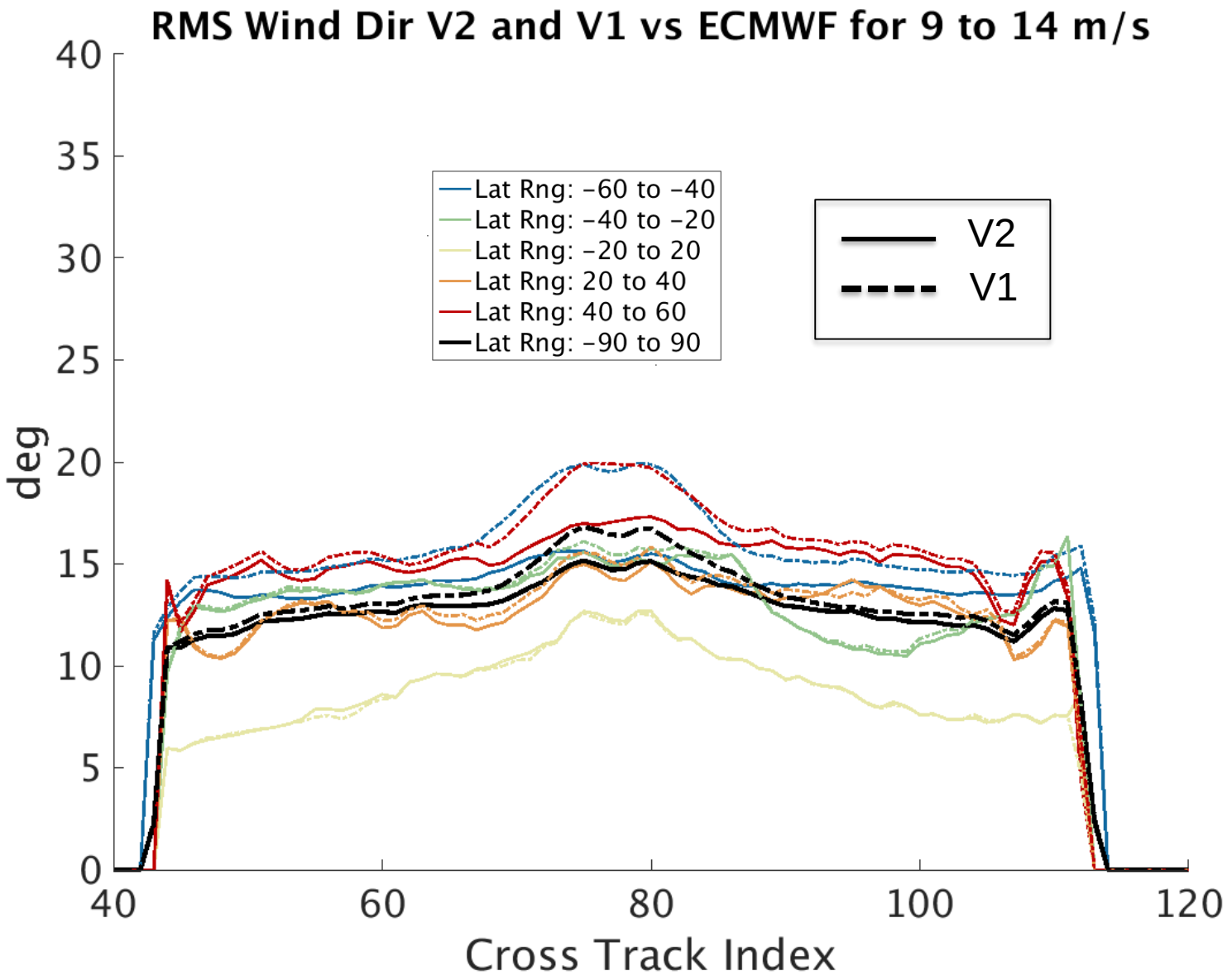


The primary improvement in version 2 due to the SST-dependent GMF is the reduction of discontinuities in the derivative field near 50 degrees South.

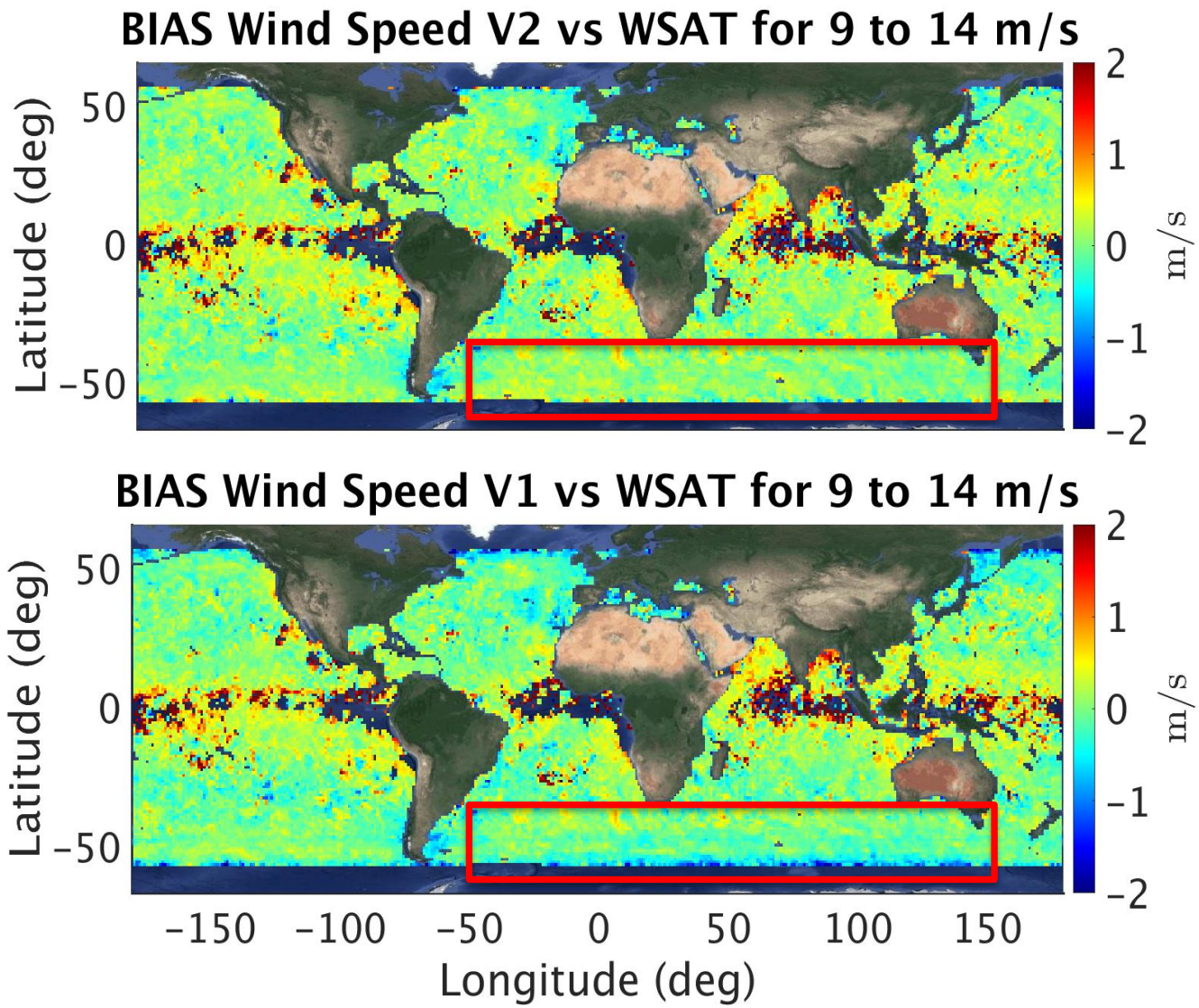
SST dependent GMF, High SNR
RMS Direction Error w.r.t ECMWF



SST dependent GMF, Low SNR
RMS Direction Error w.r.t ECMWF



SST-dependent GMF, High SNR, Speed Bias w.r.t WindSAT

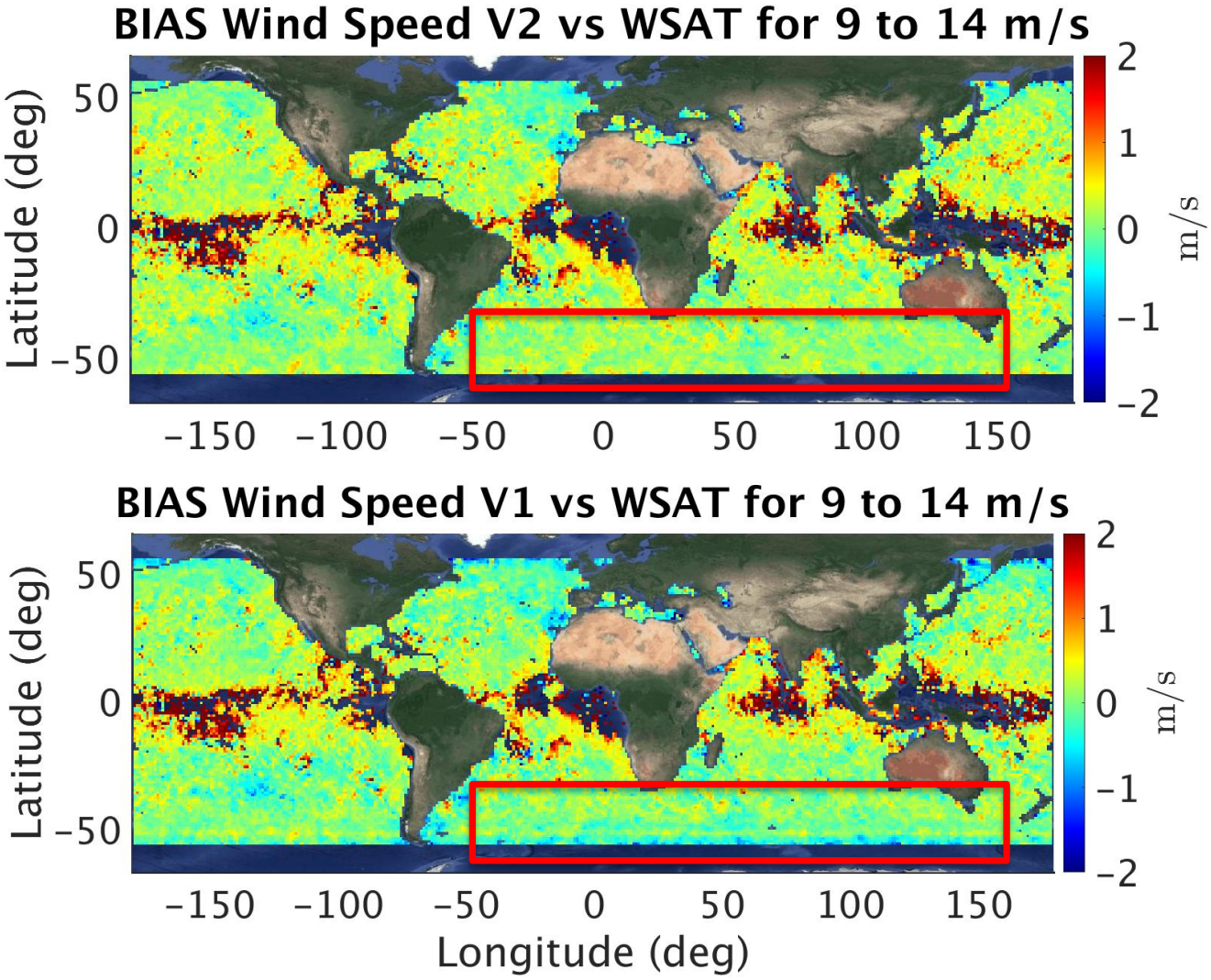


For QuikSCAT the primary improvement from the new GMF is to remove a negative speed bias at high southern latitudes, but RapidScat due to its inclination does not go so far South.

There is only a slight improvement at the Southern edge of the valid data (See red rectangles).

Black regions are missing data. Missing data near tropics are due to a combination of rain flag, wind speed regime, and colocation pattern between WindSAT and RapidScat

SST-dependent GMF, Low SNR, Speed Bias w.r.t WindSAT



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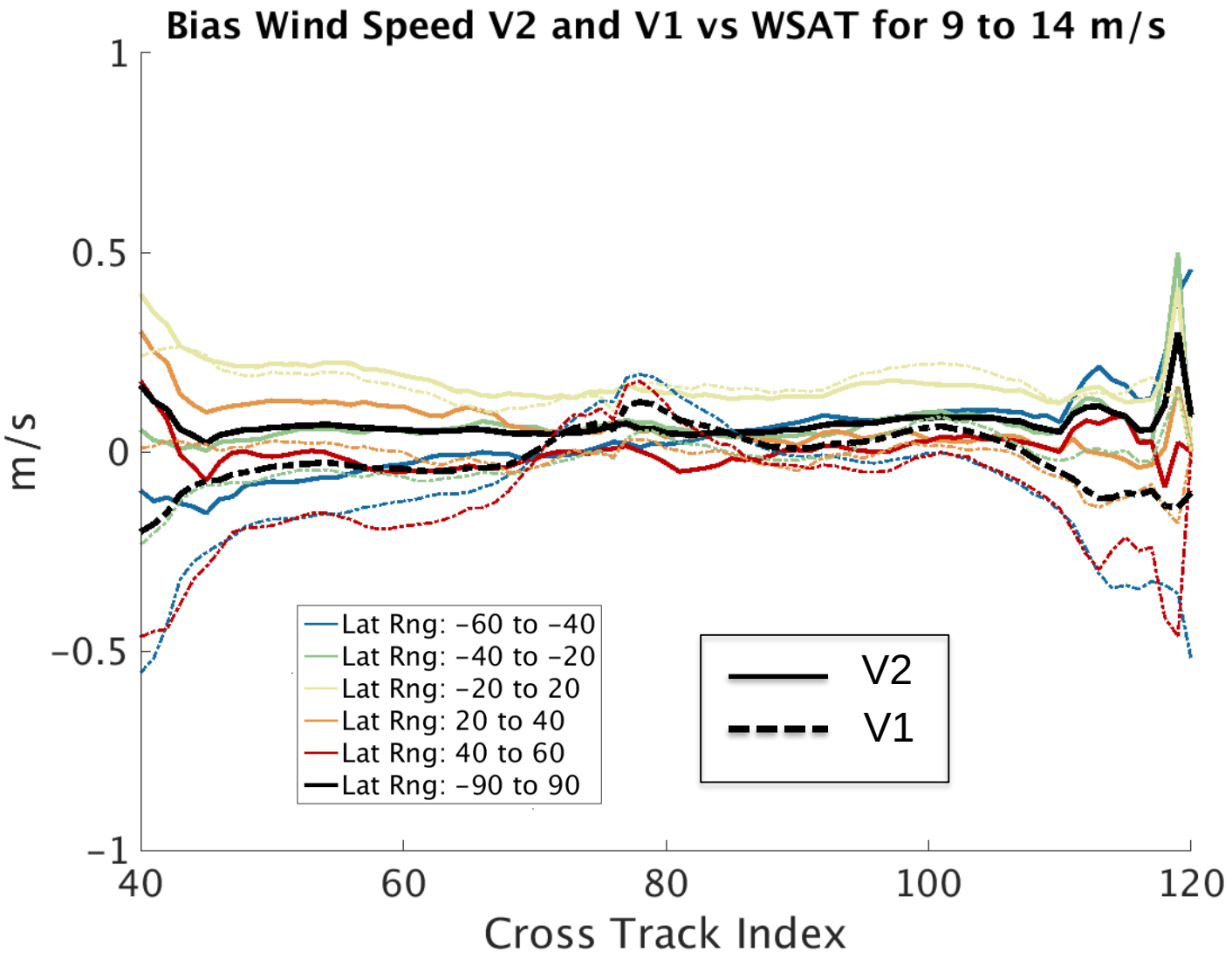

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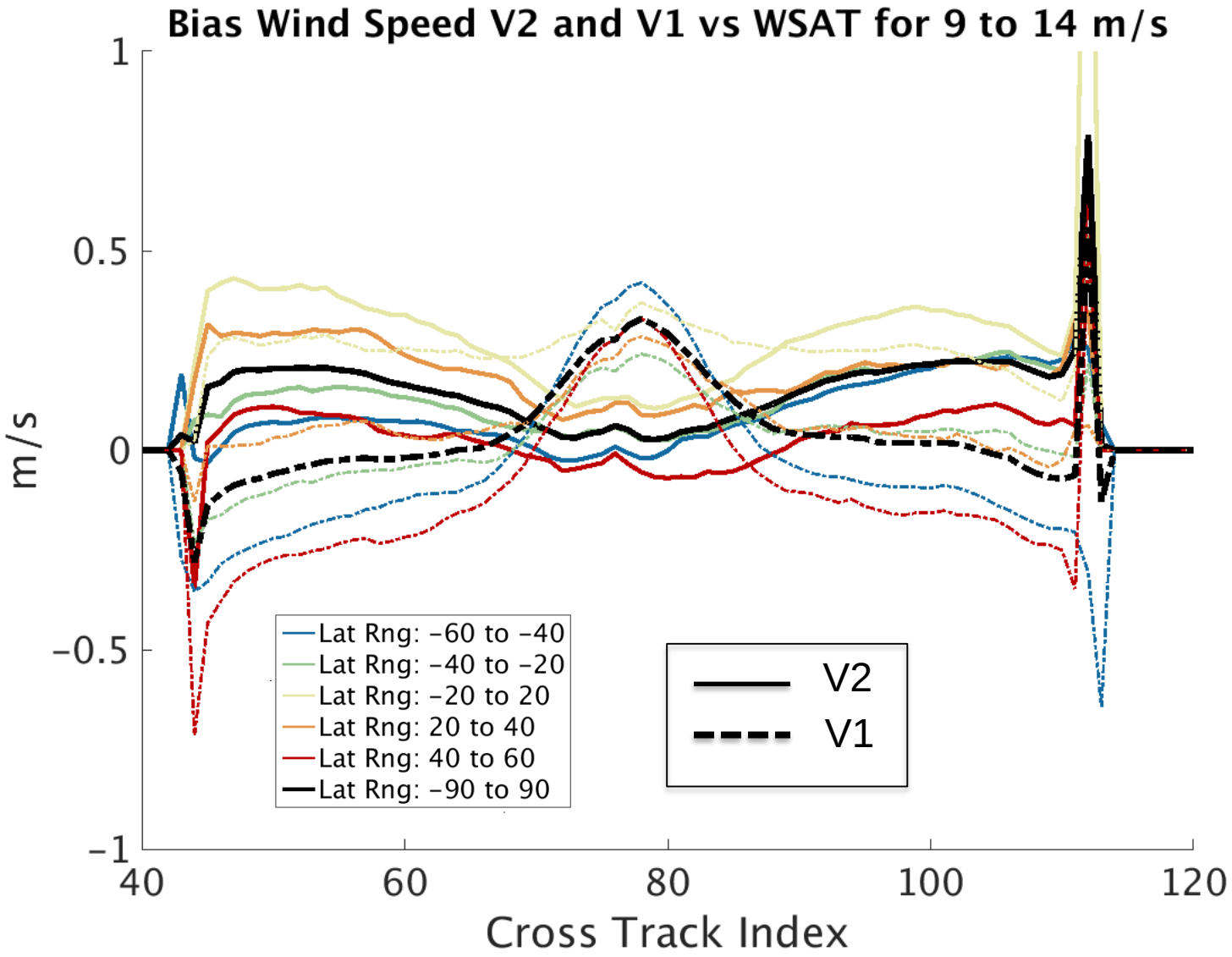
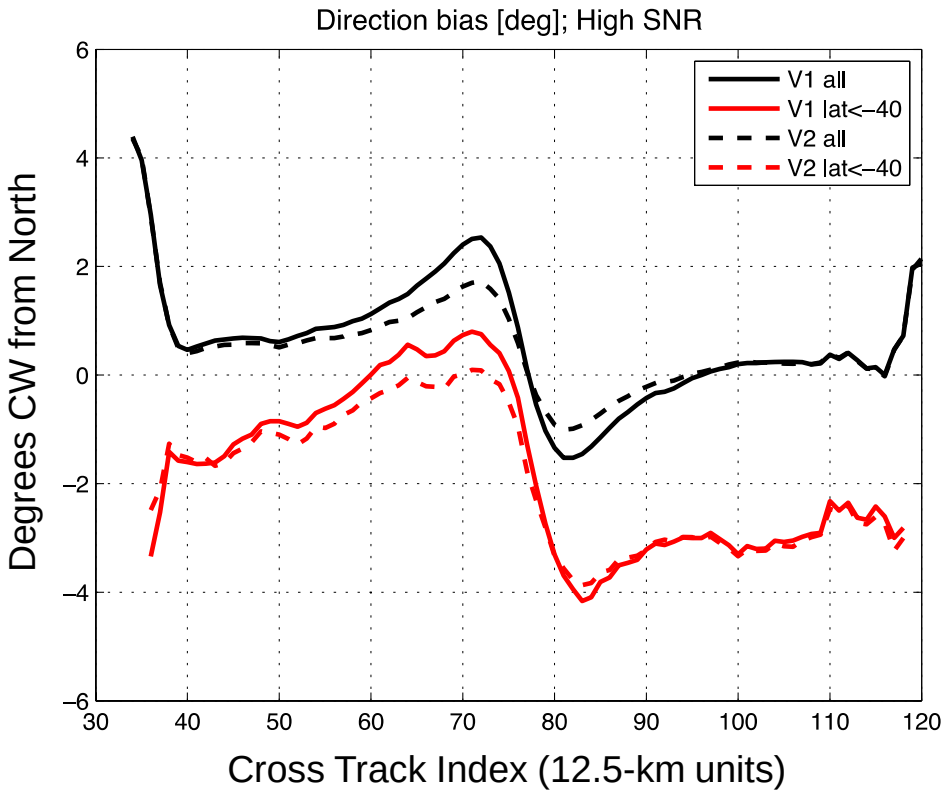


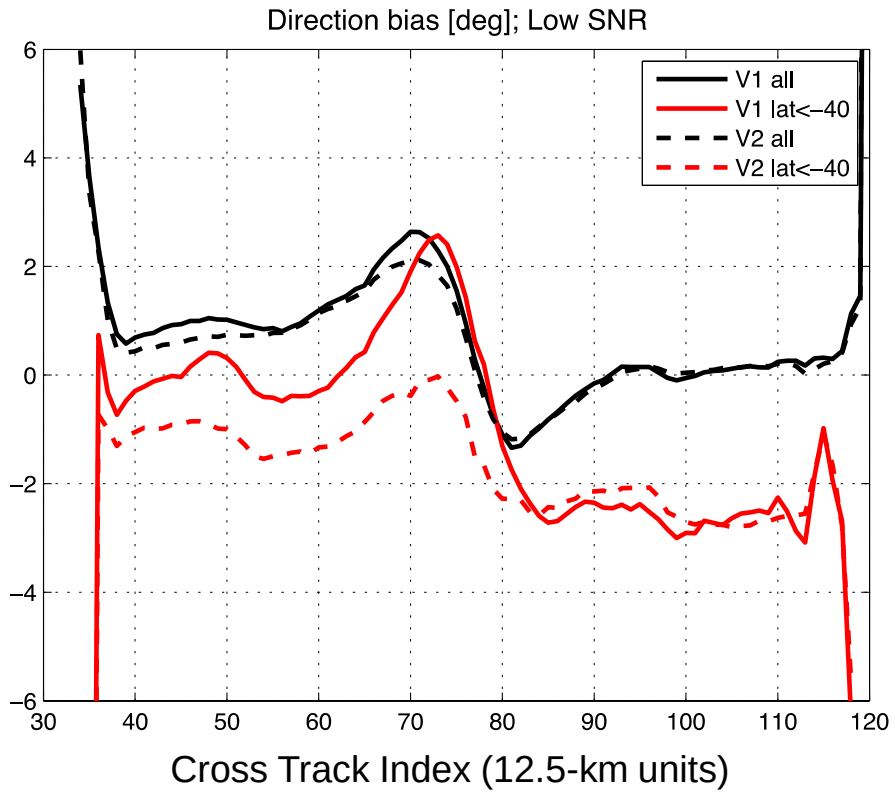
Summary

- The RapidScat Version 2.0 climate quality data set is now publicly available.
- It contains an SST-dependent GMF that
  - *Reduces biases with cross track distance for latitudes with low SST.*
  - *Reduces direction error in the center of the swath in the Southern Ocean.*
- It contains simplified quality flags and additional quality information.
- It contains coincident microwave radiometer rain rate information.
- Questions?

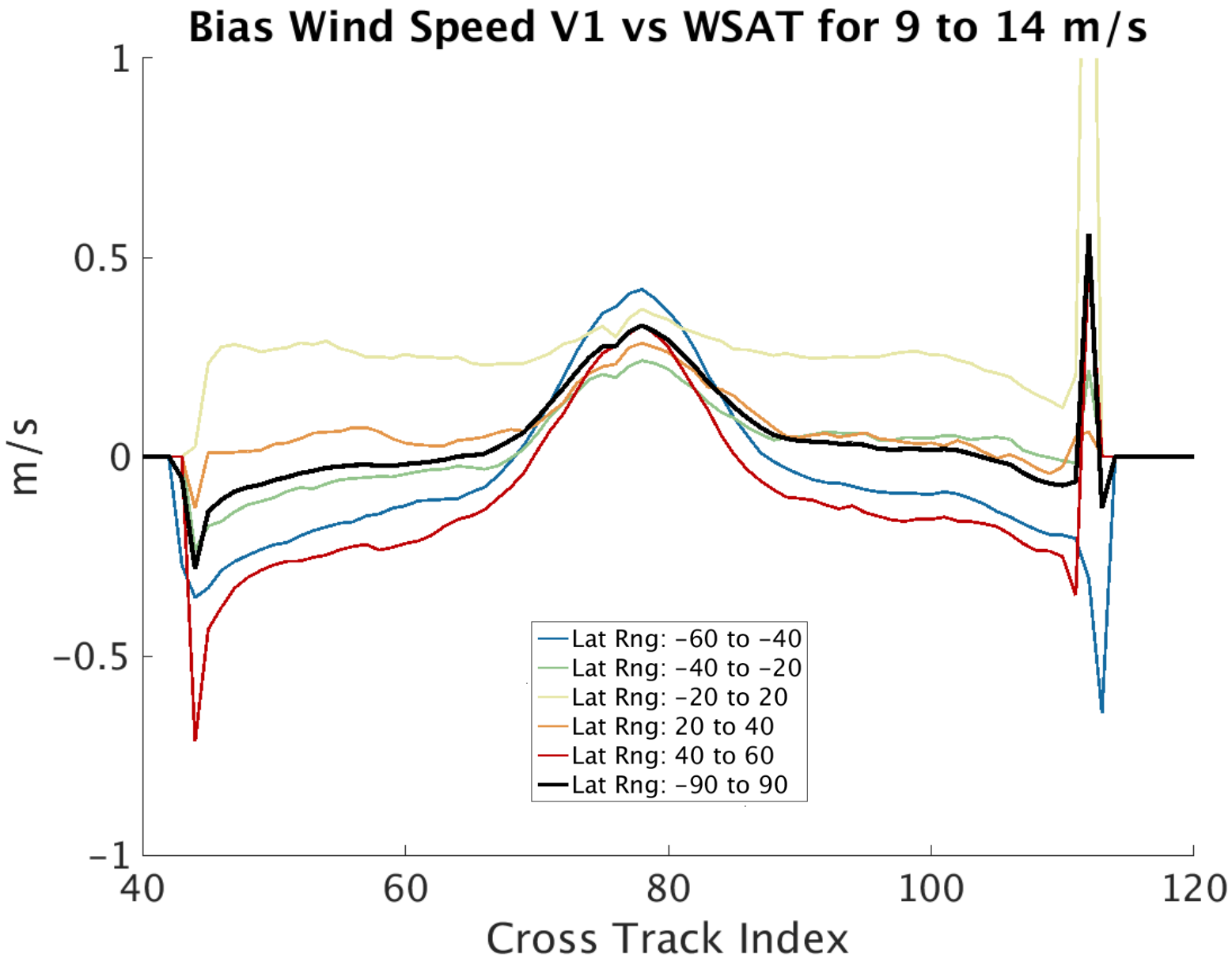
Backup Slides

SST-dependent GMF, Direction Bias w.r.t ECMWF

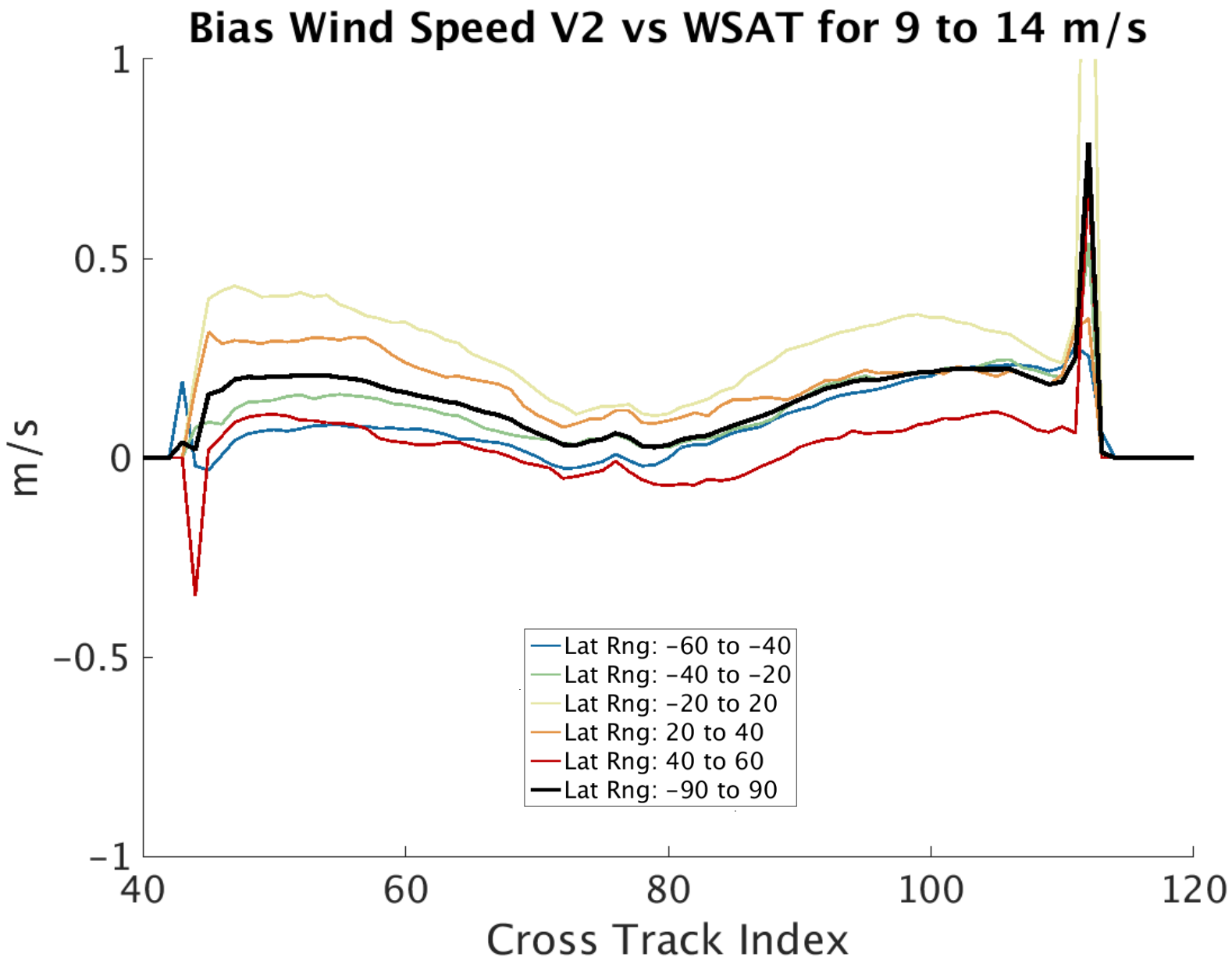




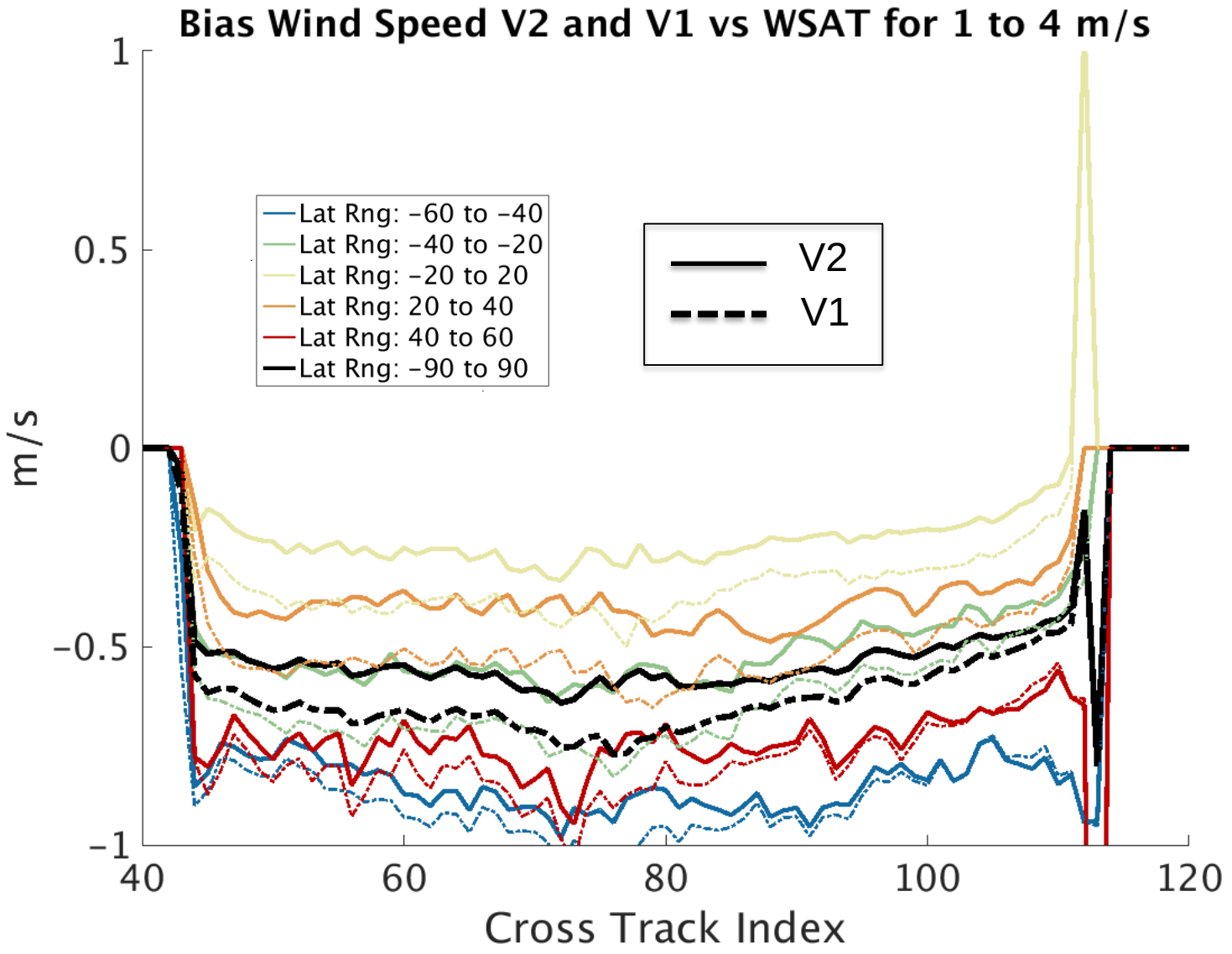
SST dependent GMF, Low SNR, V1 only, Speed Bias w.r.t WindSAT



SST dependent GMF, Low SNR, V2 only, Speed Bias w.r.t WindSAT



SST dependent GMF, Low SNR, Speed Bias w.r.t WindSAT



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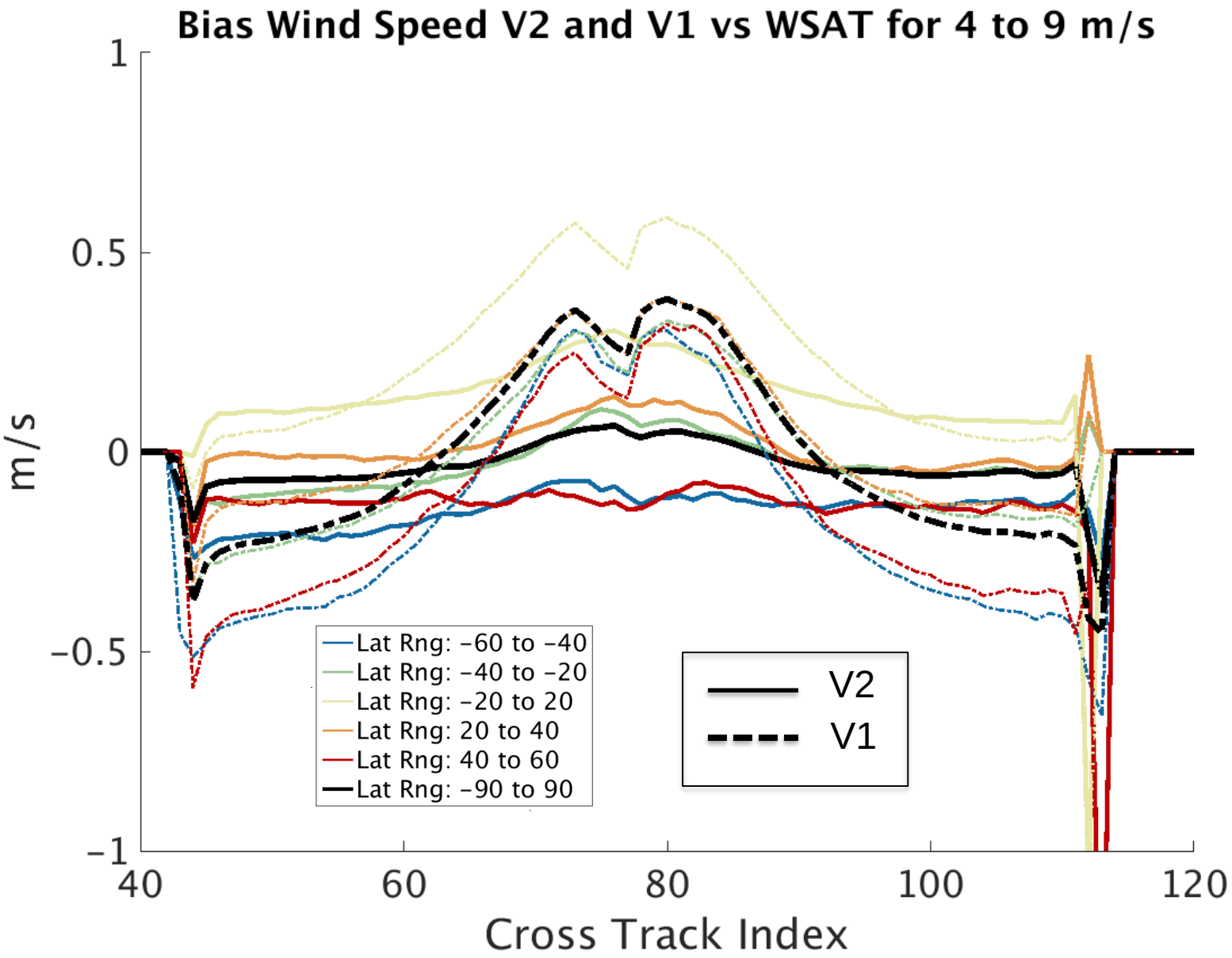

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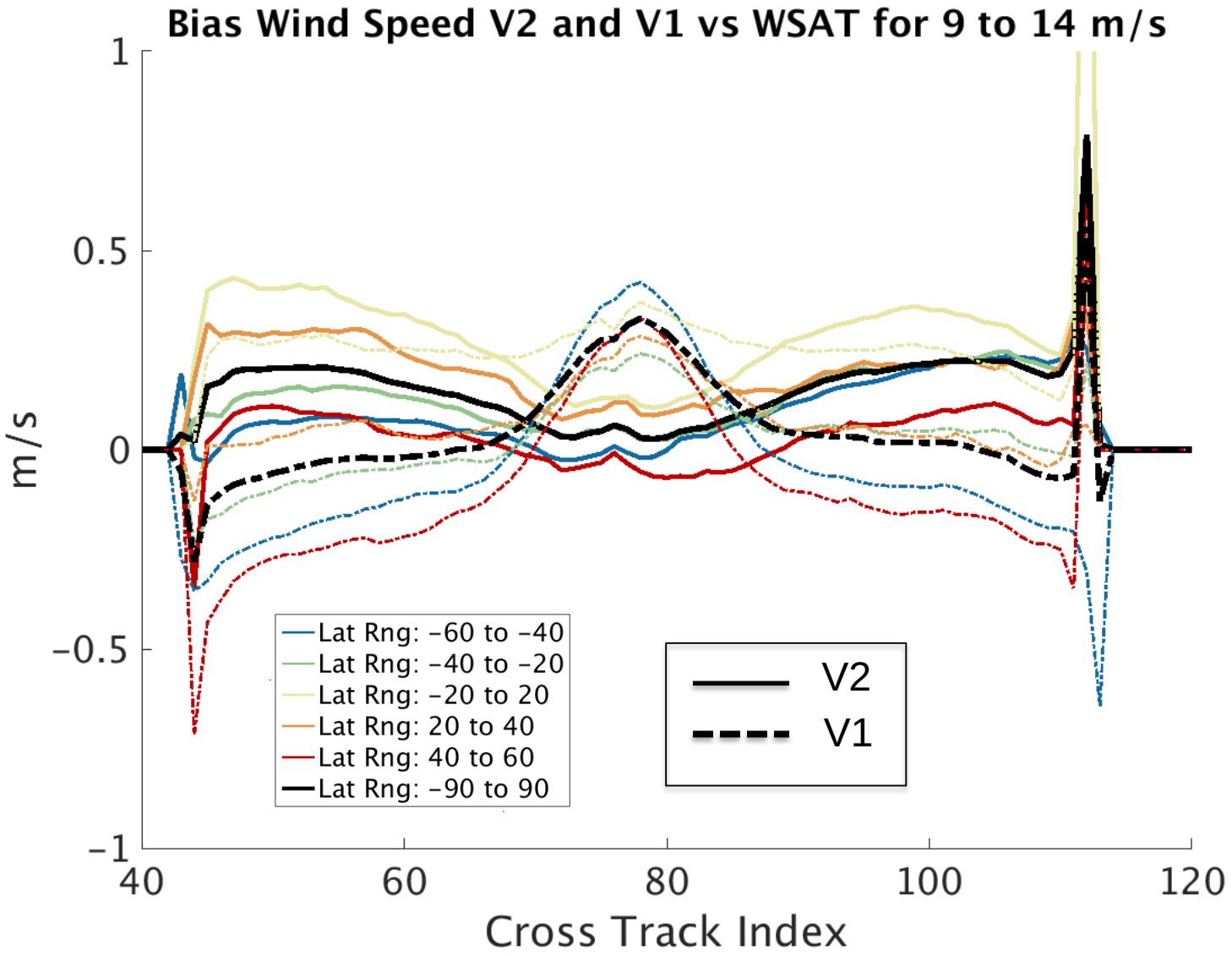

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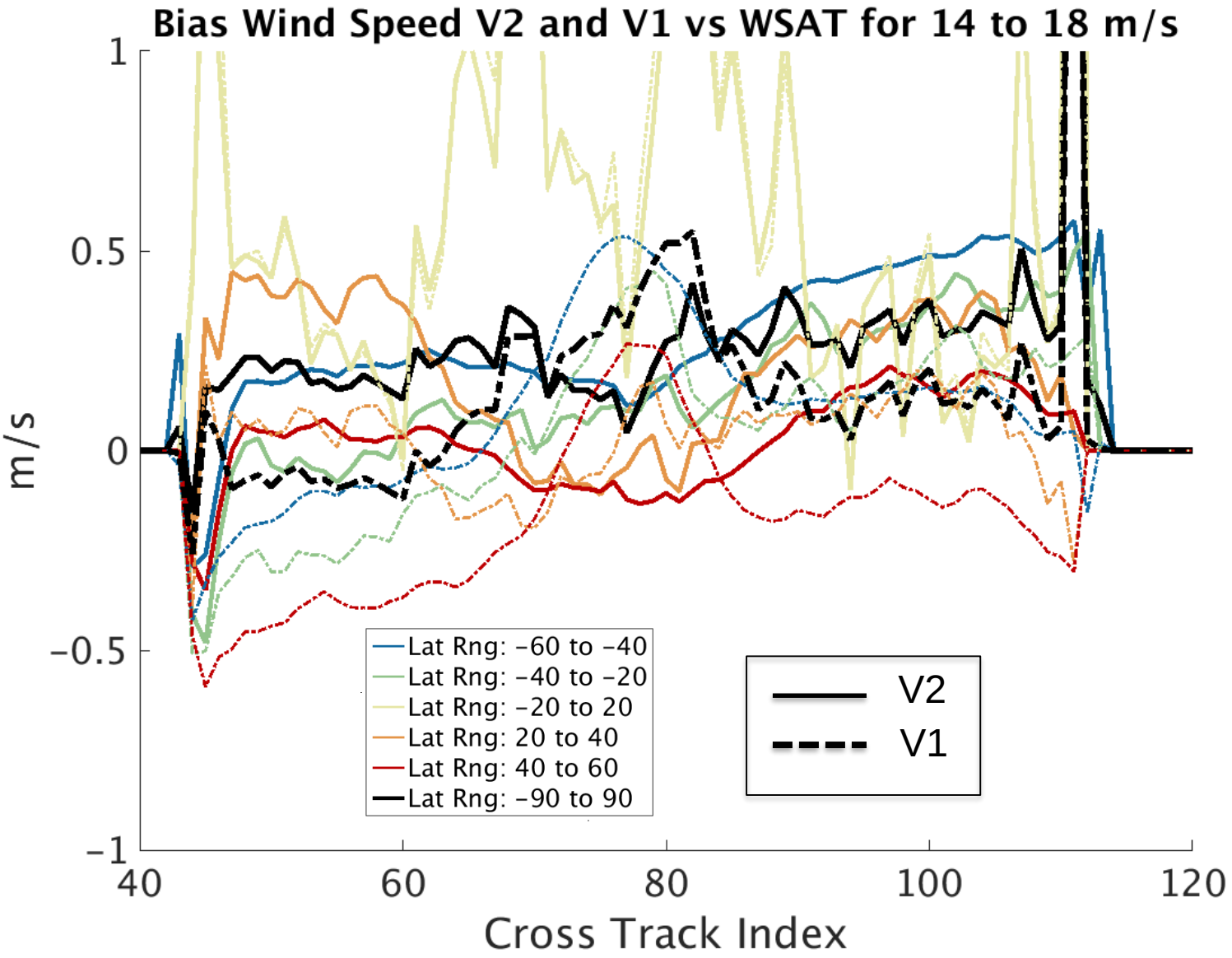
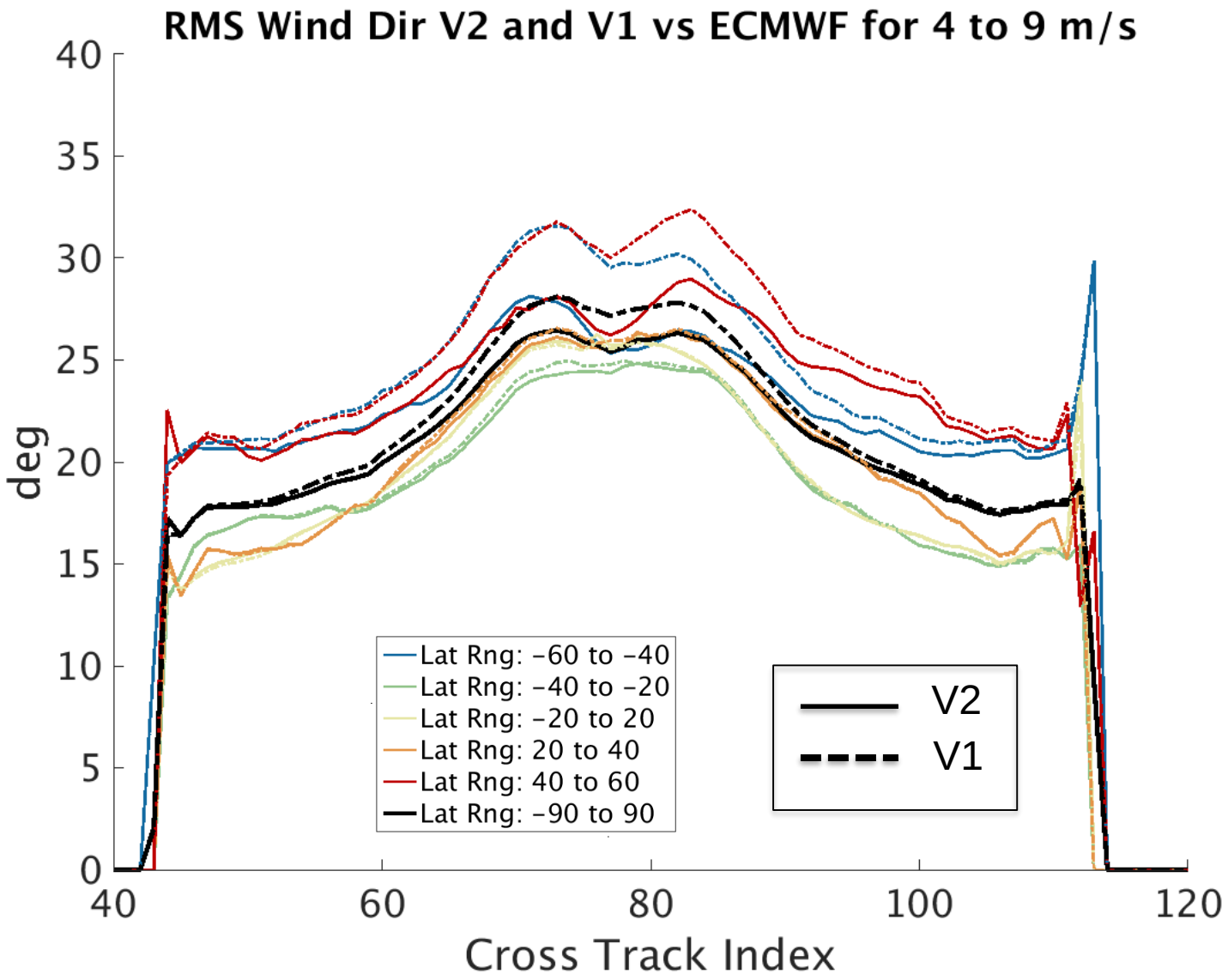
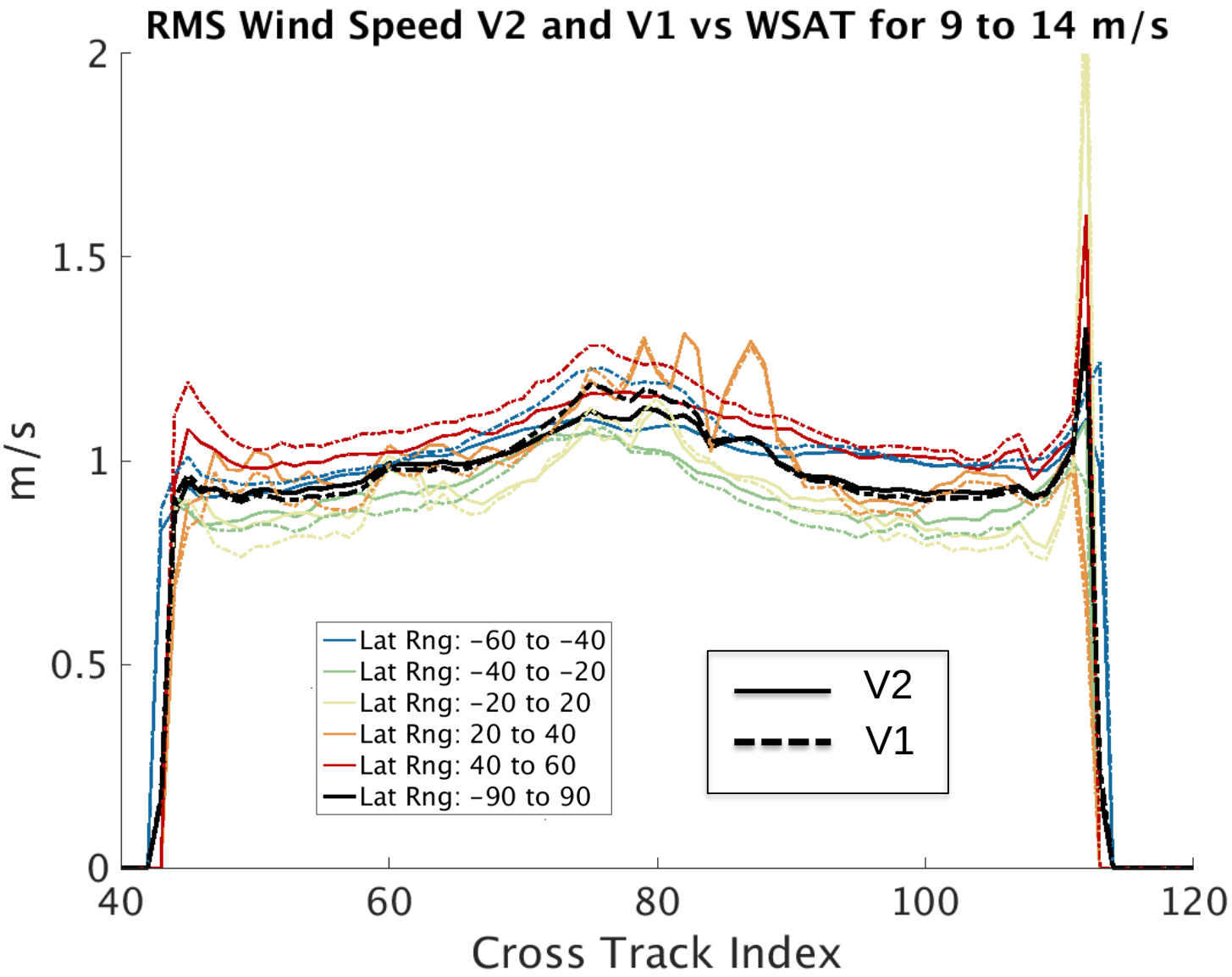


SST dependent GMF, Low SNR, Speed RMS w.r.t WindSAT



SST dependent GMF, Low SNR, Speed RMS w.r.t WindSAT



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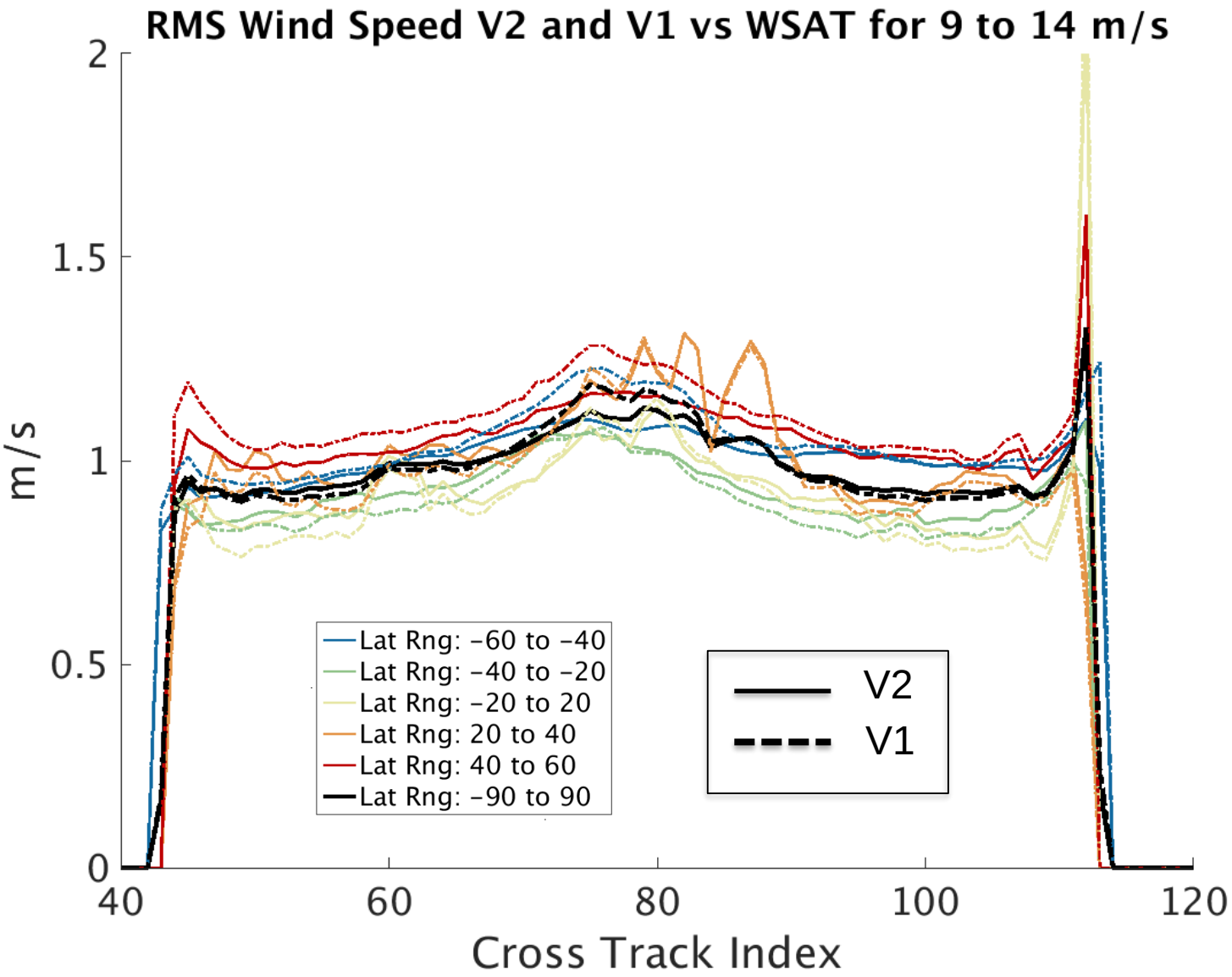
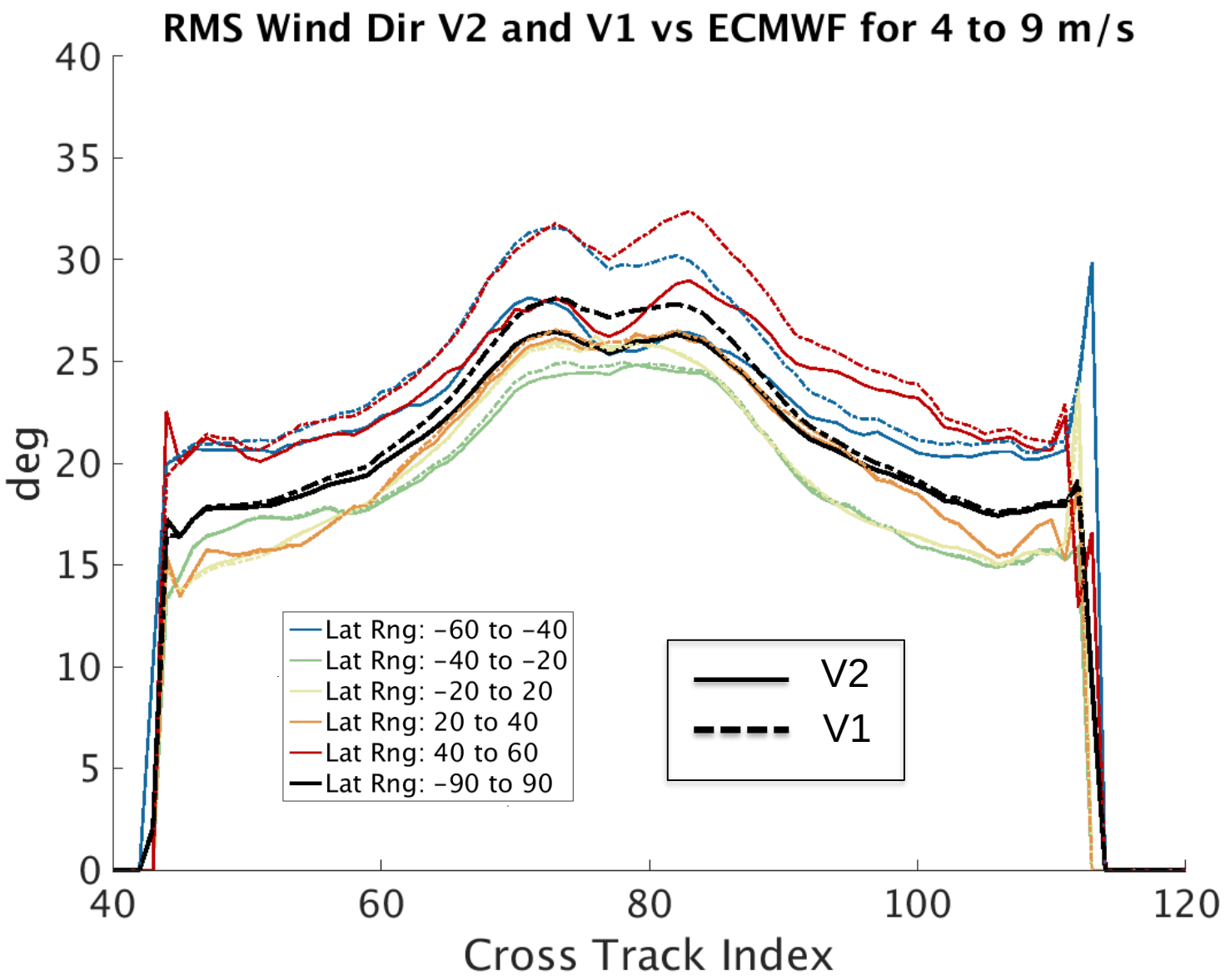


SST dependent GMF, Low SNR, Direction RMS w.r.t ECMWF



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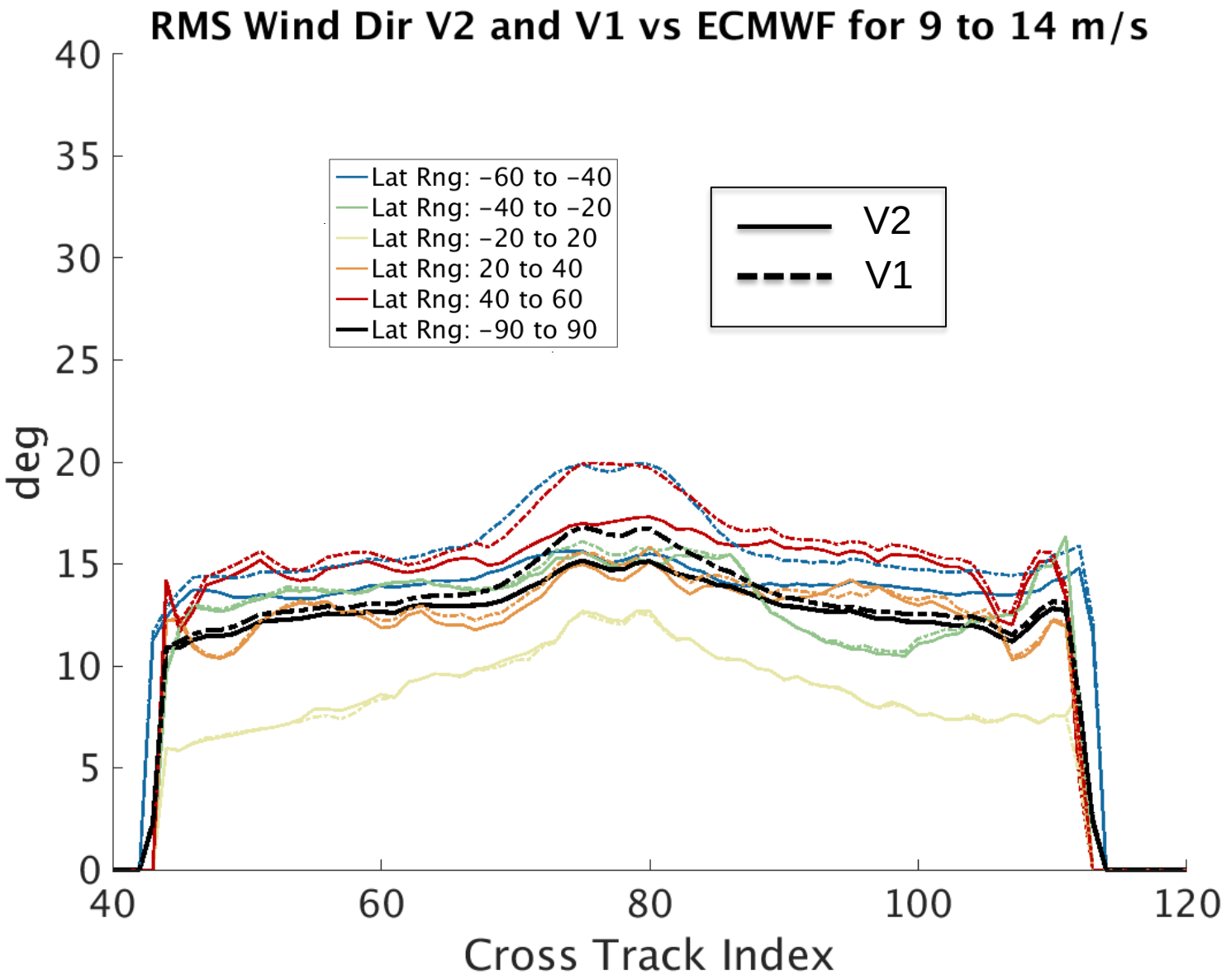
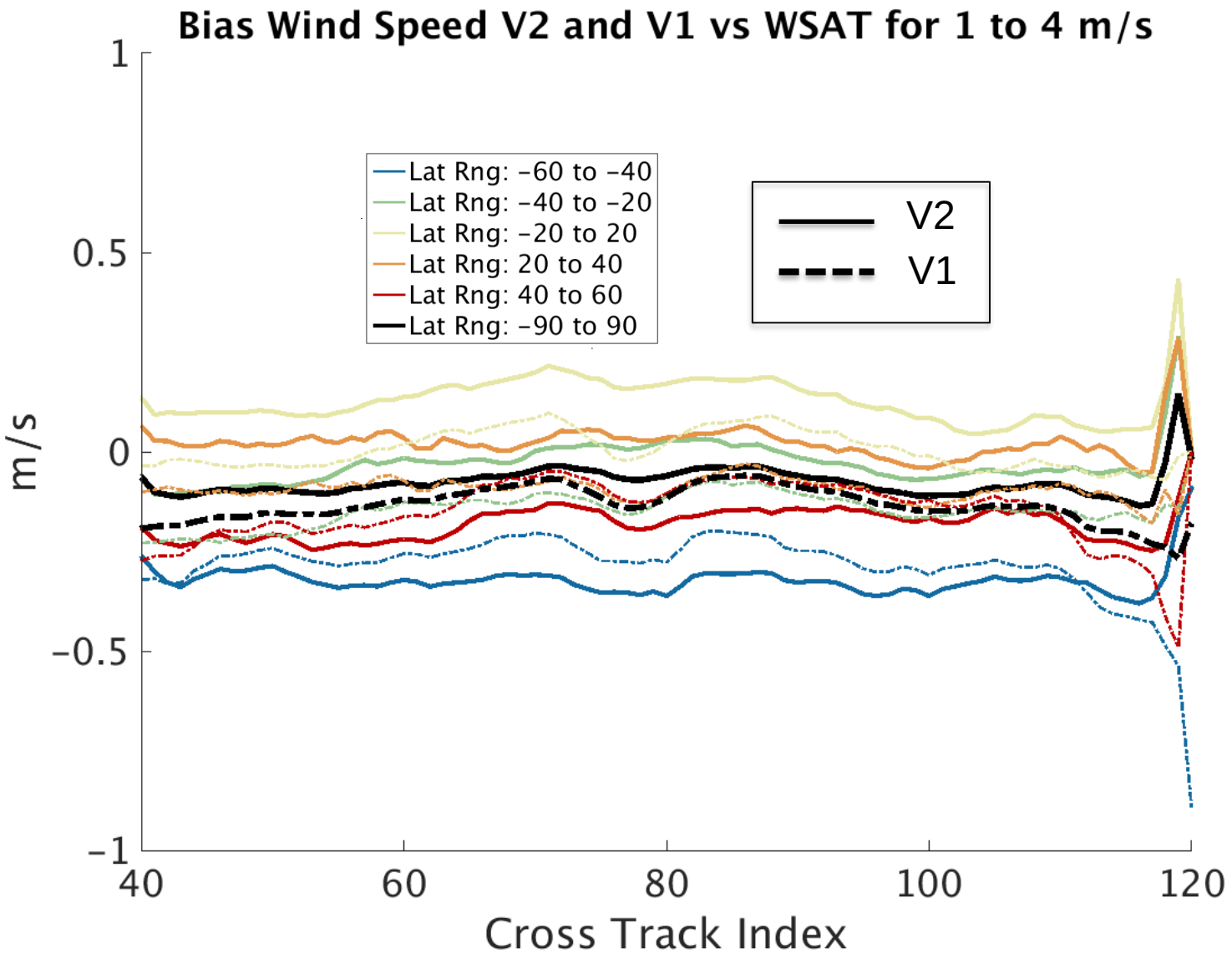


SST dependent GMF, High SNR, Speed Bias w.r.t WindSAT



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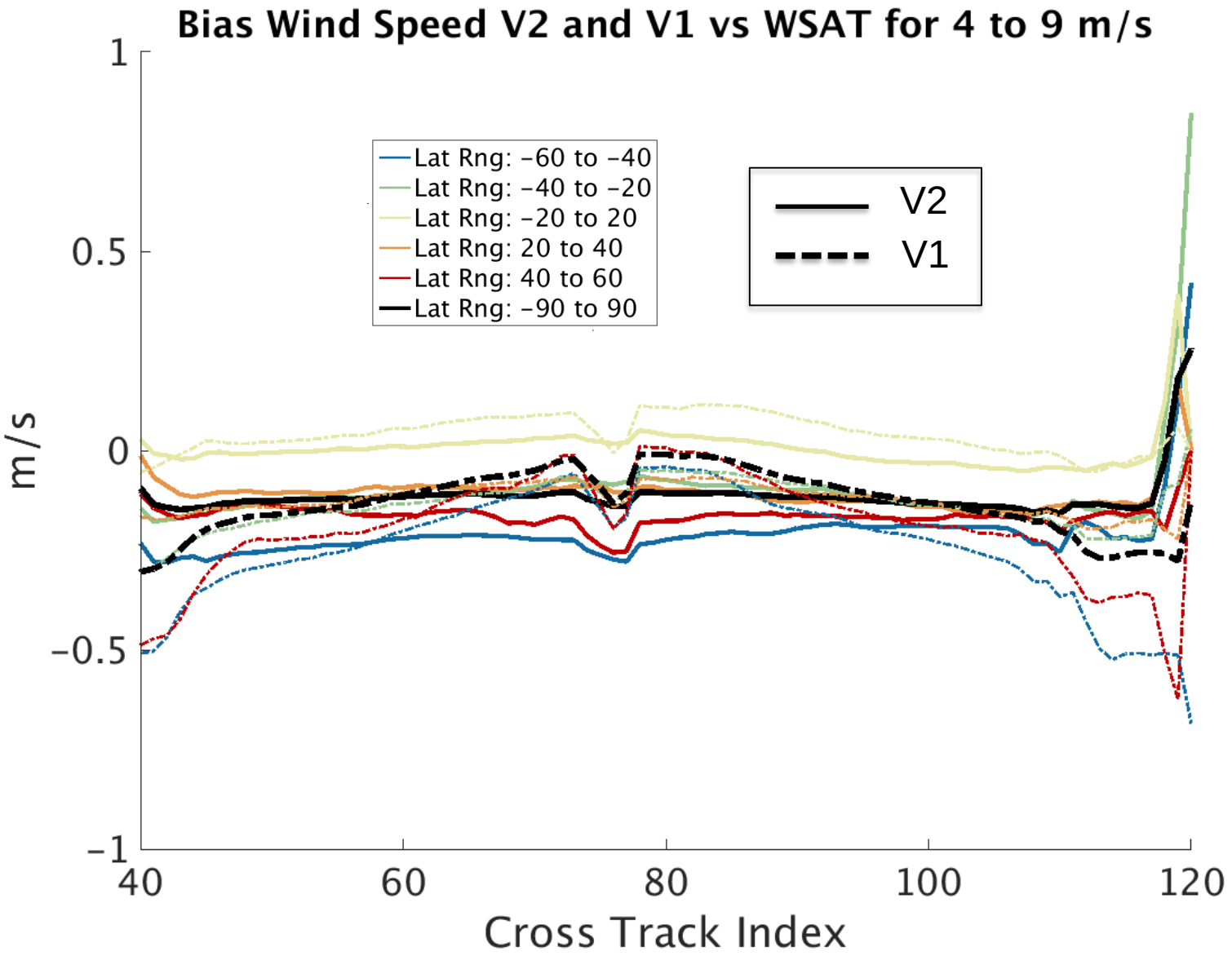

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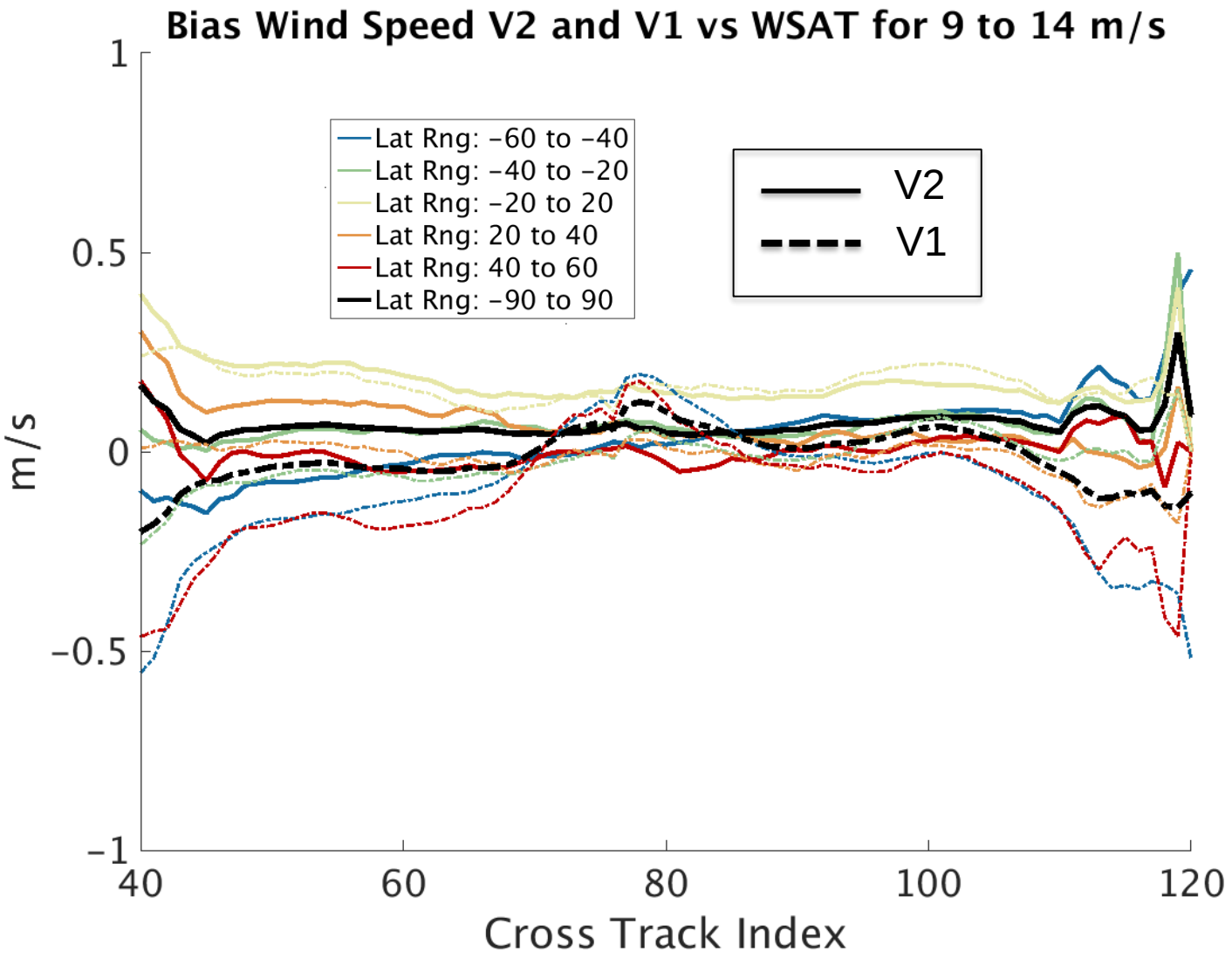

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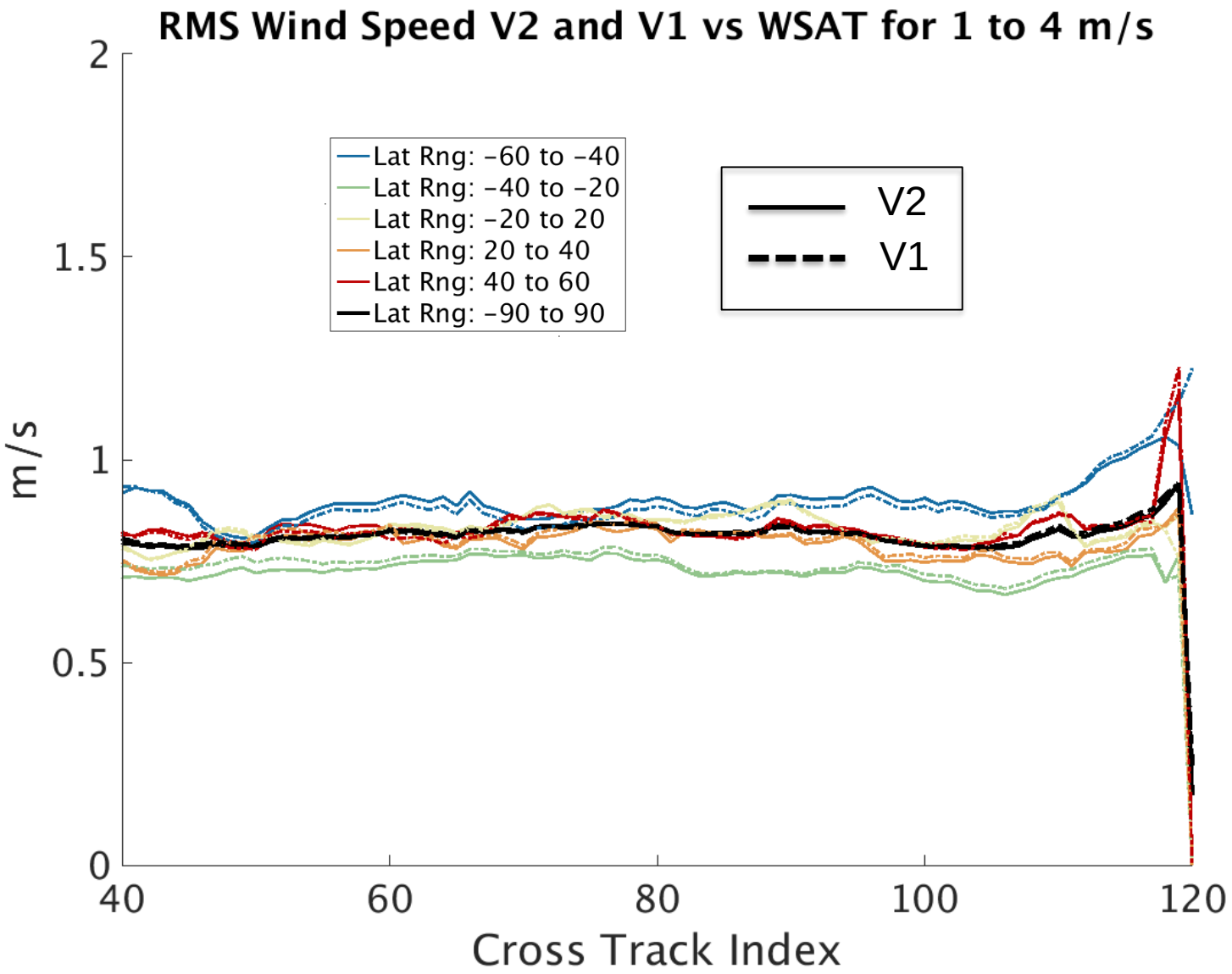

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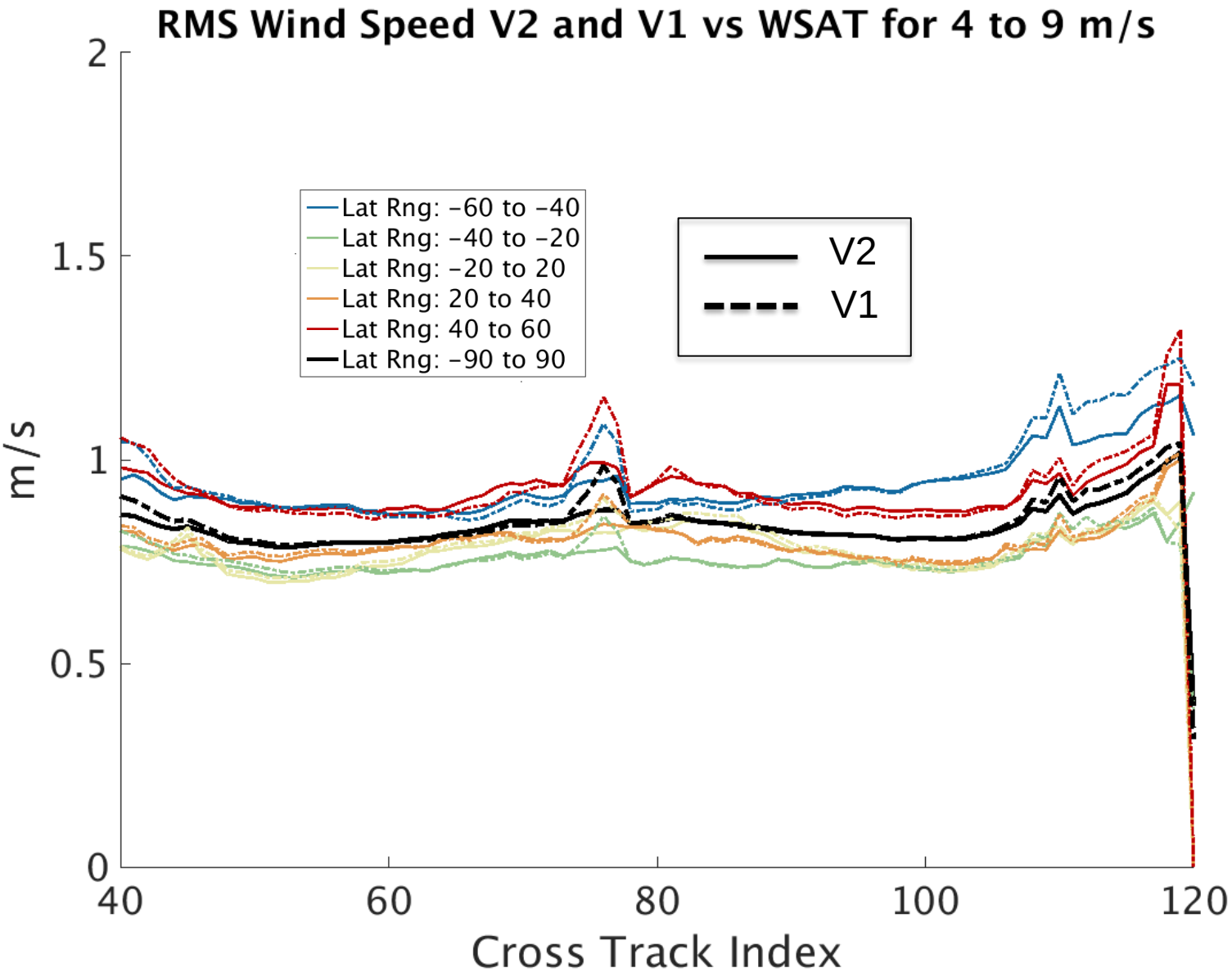

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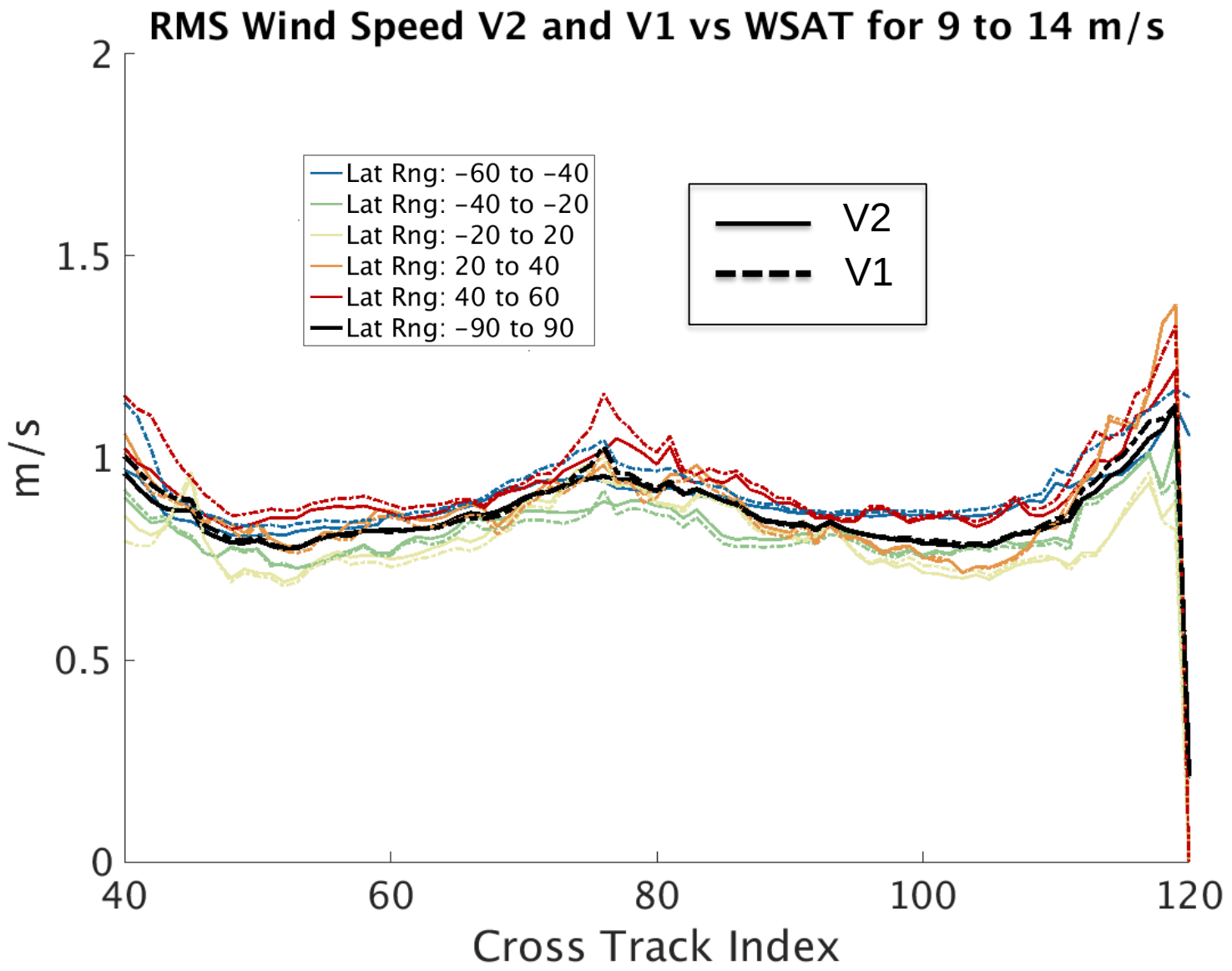
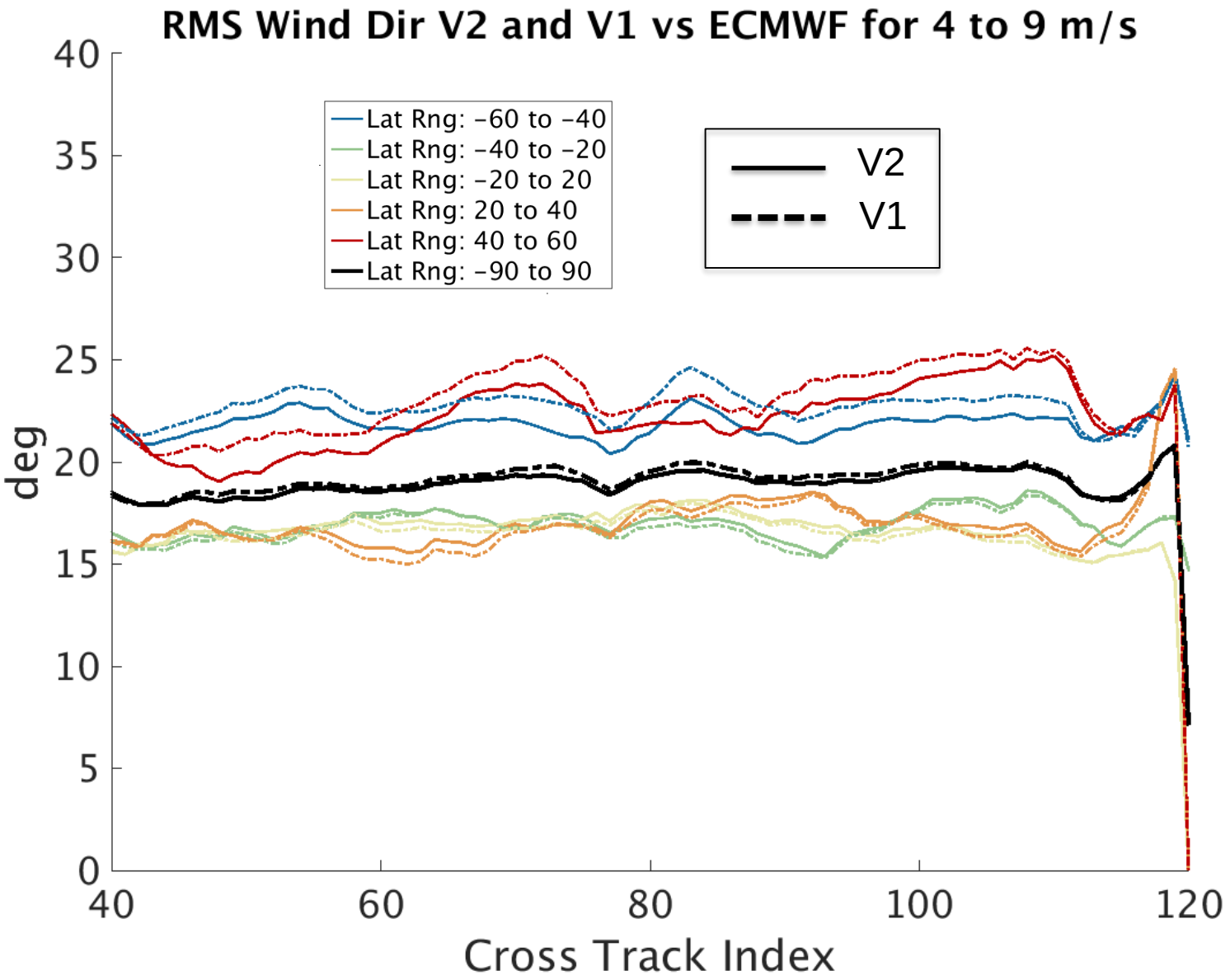
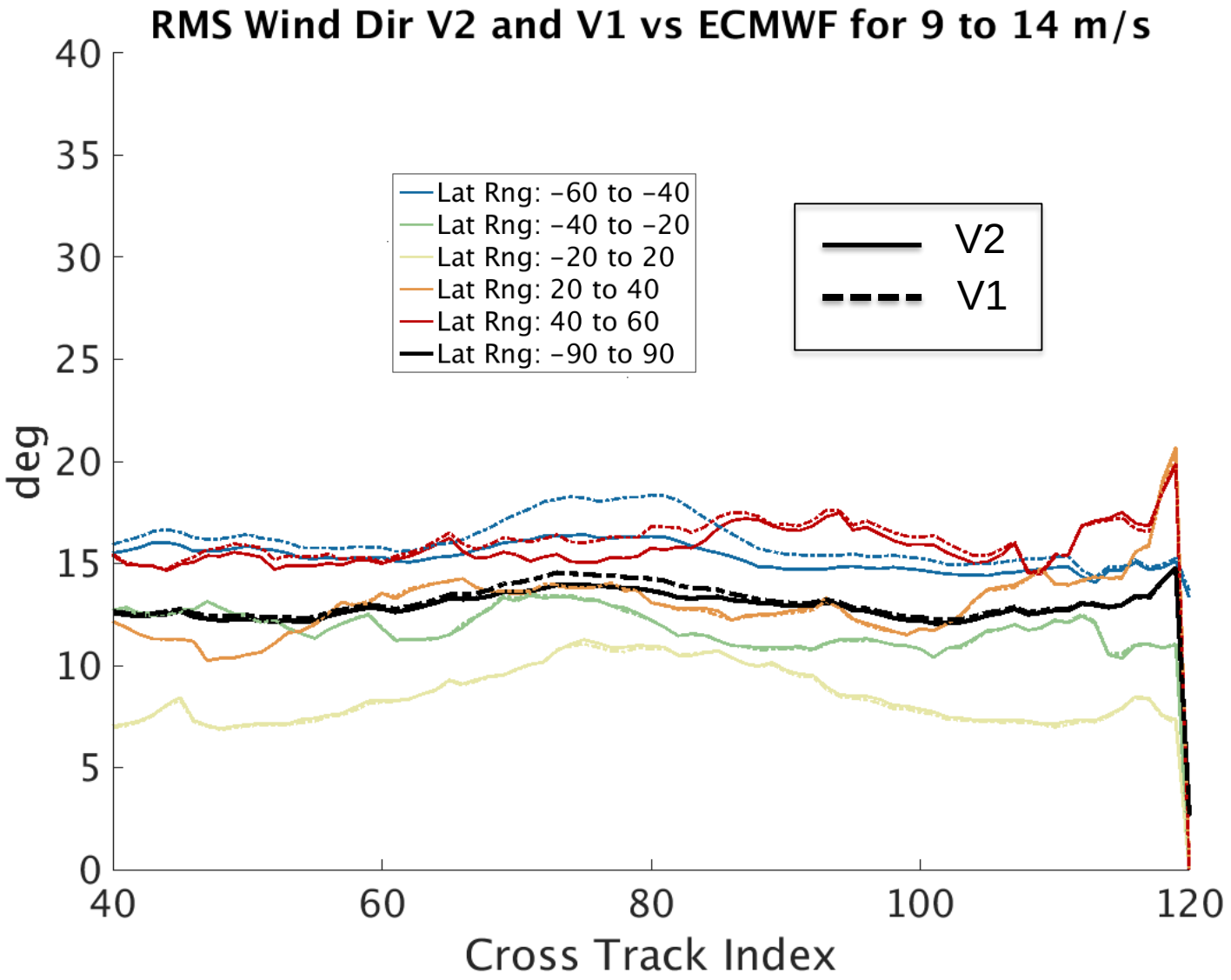


SST dependent GMF, High SNR, Direction RMS w.r.t ECMWF



SST dependent GMF, High SNR
RMS Direction Error w.r.t ECMWF



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